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# The Role of Emotionality, Self-efficacy, Rational- and Intuitive- Thinking Styles in Advanced Chess Expertise

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**ABSTRACT. Background**: Literature is scarce regarding the psychological predictors of chess expertise and A-level chess performance. **Methods**: A cross-sectional study was designed and conducted on a total number of 90 Hungarian and Romanian competitive chess players. More than half were males, the average age was 32.07 (SD=12.99). The study aimed to explore the predictive influence of age, gender, number of hours spent practicing, preferences for rational and intuitive thinking styles, self-efficacy, and emotionality on the likelihood of obtaining a publicly accessible ELO rating within the range of 1800-2500 (indicating at least A-level expertise or higher). Binary logistic regression was applied to examine the weight of each predictor. **Results:** The data evinced the statistically significant role of gender, and rational thinking style on A-level chess expertise and from all the conclusive predictors the most determinant was the rational thinking style which raised the chance of high expertise more than 60 times. **Conclusions**: Practice contributes positively to the development of A-level competence. However, the most crucial factor in predicting high chess expertise and performance is the preference for rational thinking style.

**Keywords:** chess expertise, ELO rating, A-level, emotionality, self-efficacy, rational thinking, intuitive thinking, practice, adults

**ZUSAMMENFASSUNG. Hintergrund**: Es gibt nur wenig Literatur über die psychologischen Prädiktoren für Schachkenntnisse und A-Level-Schachleistungen. **Methoden**: Es wurde eine Querschnittsstudie konzipiert und an insgesamt 90

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ungarischen und rumänischen Wettkampfschachspielern durchgeführt. Mehr als die Hälfte waren Männer, das Durchschnittsalter betrug 32,07 Jahre (SD=12,99). Ziel der Studie war es, den prädiktiven Einfluss von Alter, Geschlecht, Anzahl der Trainingsstunden, Präferenzen für rationale und intuitive Denkstile, Selbstwirksamkeit und Emotionalität auf die Wahrscheinlichkeit zu untersuchen, eine öffentlich zugängliche ELO-Bewertung im Bereich von 1800-2500 (was mindestens A-Niveau oder höher bedeutet) zu erhalten. Es wurde eine binäre logistische Regression angewandt, um das Gewicht der einzelnen Prädiktoren zu untersuchen. **Ergebnisse**: Die Daten zeigten die statistisch signifikante Rolle des Geschlechts und des rationalen Denkstils für die Schachkompetenz auf A-Niveau. Von allen schlüssigen Prädiktoren war der rationale Denkstil der bestimmendste, der die Chance auf eine hohe Kompetenz um mehr als das 60fache erhöhte. **Schlussfolgerungen**: Übung trägt positiv zur Entwicklung der A-Level-Kompetenz bei. Der wichtigste Faktor bei der Vorhersage von hoher Schachkompetenz und Leistung ist jedoch die Präferenz für den rationalen Denkstil.

**Schlüsserwörter:** Schachexpertise, ELO-Bewertung, A-Level, Emotionalität, Selbstwirksamkeit, rationales Denken, intuitives Denken, Praxis, Erwachsene

## INTRODUCTION

### *The role of rational thinking, deliberation and practice in chess expertise*

The significance of careful practice and rigorous learning in developing outstanding chess skills is crucial for achieving success in chess (Charness et al., 2005). Chess performance and competence are influenced by specific cognitive characteristics, including memory and attention abilities, theoretical knowledge, and the amount of time dedicated to practice (Bilalić et al., 2008). Moreover, the quantity of games played, the amount of time dedicated to practice, and the deliberate study of chess are highly associated with chess performance, indicating the educational process that contributes to achieving high scores (Howard's, 2011; Charness et al., 2005; Li et al., 2015).

Furthermore, research on neurocognition has identified specific brain regions involved in analytical thinking that are activated in chess players during gameplay (Saarilouma et al., 2004). EEG recordings of high-performance players revealed that during rapid and lightning chess games, the right hemisphere had greater activity than the left hemisphere. This asymmetry can be attributed to the involvement of visuospatial processing (Villafaina et al., 2021). Positron emission tomography (PET) was used to examine chess players with an average of 37 years of experience. The study found that the

temporal region of the brain was active during the memory test, while the frontal brain areas were involved in problem-solving activities (Saarilouma et al., 2004).

Additionally, empirical research demonstrated that individuals who exhibited superior performance in chess games engaged in a higher degree of logical analysis when considering their options (Bilalic, et al., 2008; Charness, 1981). The cognitive reflecting behaviors and planned actions that are linked to achieving good chess performance are predominantly rooted in logical and reasonable thinking. This notion is supported by various studies, including those conducted by de Groot (1978), Ericsson and Charness (1994), Cumming et al. (2005), and Gobet and Charness (2006).

### *The role of intuitive thinking in chess expertise*

In addition to examining deliberate and rational thinking, researchers have also investigated the role of intuition in the performance of chess masters. The findings indicate that both cognitive systems are present in high-stakes chess games (Dreyfus & Dreyfus, 1987; Kahneman & Frederick, 2005; Moxley et al., 2012). Chess players are regarded as being more intuitive than the general population, and greater expertise among chess players was linked to higher scores in intuition (Kelly, 1985).

The literature (Raab & Johnson, 2007) emphasized the connection between the "take-the-first" heuristic and intuition. Intuition is evident in the effortless identification of patterns and the rapid retrieval of associated methods. In the context of chess playing, intuition appears to be most apparent in straightforward issue scenarios. Intuitive and automatic thinking is driven by the unconscious activation of past experiences. The more knowledge and expertise a person has in a certain area, the more they may rely on it, even at a preconscious level. Previous research (Gigerenzer & Brighton, 2009; Raab & Johnson, 2007; Moxley et al., 2012) has demonstrated that this strategy serves as a mediator for enhancing expert chess decision making.

The cognitive processes that underlie intuition were previously associated with learning and recalling information, automatically integrating information from memory and current perception, and constructing stable mental representations (Glöckner & Witteman, 2010). Intuition is also associated with the process of acquiring knowledge (Betsch & Glöckner, 2010). Empirical evidence indicates that experts employ a combination of analysis and intuition in their decision-making process. Furthermore, it has been observed that the effectiveness of their intuitive decision-making is enhanced when they are afforded extra time to deliberate on their choices (Moxley et al., 2012).

Another viewpoint suggests that intuition may be cultivated by intentional practice and is based on knowledge gained from training (Betsch & Glöckner, 2010). According to studies by Chase and Simon (1973) and Gobet and Simon (1996), intuition is associated with the capacity to change gameplay and memory function quickly. It is considered that professionals are able to swiftly retrieve the appropriate action from memory due to intuitive processes that rely on pattern recognition. Based on these concepts, the expert is able to recognise specific characteristics that act as cues for recalling the correct actions by gathering a significant amount of knowledge related to familiar patterns.

### *The role of personality and self-efficacy in chess expertise*

Chess players who perform at a high level are more likely to have introverted tendencies compared to their colleagues with a lower ELO score. Regarding female chess players, it was found that those who were more skilled exhibited higher levels of extroversion and above the average in areas such as life satisfaction and performance orientation (Vollstädt-Klein et al., 2010). Many high-performance sport talents exhibit traits such as high emotional stability, conscientiousness, and sociability (Hackfort & Schinke, 2020; Steca et al., 2018). A study conducted by Allen et al. (2011) found that athletes who are more extroverted and emotionally stable tend to employ problem-focused coping strategies more frequently compared to their more introverted or emotionally unstable peers. According to Bilalić et al. (2008), highly skilled chess players are set apart from the normal population by their elevated levels of emotional stability and control.

Individuals with high levels of self-efficacy demonstrated notably superior performance in tasks that necessitated cognitive engagement. Furthermore, the combination of self-efficacy and confidence in one's self-efficacy proved to be predictive of cognitive performance in these tasks (Horcajo et al., 2022). The study conducted by Jianguo et al. (2018) emphasized that chess playing in an experimental environment had an effect on self-efficacy.

Based on the information provided, we can conclude that chess performance, high ELO scores, and overall consistency among chess players are connected to emotional stability and self-efficacy. These psychological factors play a crucial role in determining the outcome of chess games.

## AIM OF STUDY

The existing literature is limited in the exploration of the psychological factors that contribute to advanced chess expertise. This research was conducted to address this gap in knowledge. The main objective of the study was to investigate the predictive role of factors influencing A-class chess performance and expertise (ELO rating in the interval of 1800-2500). The exploratory approach focused on variables such as age, practice hours, gender, emotionality, self-efficacy, and self-declared thinking style (rational or intuitive). The current investigation was carried out on a population consisting of individuals with advanced chess skills from Romania and Hungary, a seldom-studied sociocultural context from this perspective.

## MEASUREMENT AND METHODS

### *Participants*

Totally 90 participants were eligible for the study. Male and female competitive chess players from Romania and Hungary were recruited online and directly in chess clubs, via the snowball method. Having at least a rating of 1000 points ELO publicly available was an eligibility criterion. After entering the study, participants were divided into two groups, based on the overall highest ELO rating one has ever reached. The chess rating system (Elo, 1978) divides the players into different classes, based on their ELO points and skills level. While the first group includes Class E, D, C and B players, the second group consists of players of Class A up to Senior Master level. Descriptive statistics of the two groups mentioned before are presented in Table 1.

## MEASUREMENTS

### *Demographic Information*

All data has been collected through an online survey. The questionnaire included items referring to general demographic information such as age, gender, education, and job profile, but also contained questions about ELO rating, tournament participation and training intensity. In the present study we focused on the highest ELO rating one has ever reached, instead of real time points. Furthermore, weekly practicing hours average was also asked for. The socio-demographic information is presented in Table 1.

**Table 1.** Descriptive statistics of participants divided into lower and higher ELO rating groups (Binary Regression Analysis Groups)

| | Group 1<br>(1000-1799 ELO rating)<br>(N = 56) | Group 2<br>(1800-2500 ELO rating)<br>(N = 34) |
|---|---|---|
| Age | 33.30 ± 13.27 | 30.85 ± 12.72 |
| Gender (N, %) | | |
| Male | 27 (48.2%) | 21 (61.8%) |
| Female | 29 (51.8%) | 13 (38.2%) |
| Education (N, %) | | |
| High school without graduation | 1 (1.8%) | 2 (5.9%) |
| Technical school | 2 (3.6%) | 1 (2.9%) |
| High school graduate | 21 (37.5%) | 8 (23.5%) |
| College graduate | 32 (57.1%) | 23 (67.6%) |
| Job profile (N, %) | | |
| non-STEM | 22 (39.3%) | 9 (26.5%) |
| STEM | 33 (58.9%) | 25 (73.5%) |
| Mixed | 1 (1.8%) | 0 (0.0%) |

### *Practicing hours and performance/expertise coding*

We collected self-reported data about the highest ELO rating the participants have ever reached to compare the skill levels of the players and create two separate groups based on this information. Expert chess performance can be objectively measured in ELO scores (Élő, 1978). This score is calculated depending on the results achieved against different opponents, with cumulative distribution function, so the players can not only add to the ELO point, but also lose from it in unfavorable cases. Based on the ELO score

thus obtained, the players are classified into the following categories: E (1000-1199 ELO), D (1200-1399 ELO), C (1400-1599 ELO), B (1600-1799 ELO), A (1800-1999 ELO), Expert (2000-2199 ELO), Master (2200-2399 ELO) and Senior Master (2400+) categories.

### *Rational and intuitive thinking style*

The studied information processing systems based on the cognitive-experiential self-theory (CEST) were measured via the Rational *Experiential Inventory.* This questionnaire has two main subscales, one concentrating on the rational style (e.g., "I prefer complex problems to simple problems.") and the other on the experiential/ intuitive style (e.g., "I believe in trusting my hunches.") (Bognár, Orosz & Büki, 2014; Epstein, Pacini, Denes-Raj & Heier, 1994; Reyna & Ortiz, 2016). The inventory consists of 40 items and the overall Cronbach's Alpha value is 0.87 for the rational scale and .86 for the experiential scale, consisting of 20 items each. Subscales, such as ability and engagement were not included in data processing.

The cognitive-experiential self-theory ("cognitive-experiential self-theory - CEST") refers to the presence of two types of information processing systems: a rational/analytical one and an associative/automatic/intuitive one.

The rational system is based on verbal reasoning and logical reasoning, uses higher-level cognitive processes and searches for the answer through analysis, which is why it is more time-consuming to rely on this processing system. On the other hand, during the use of the intuitive system, as can be seen from the previous definition, a fast, less demanding, automatic process takes place, which is based on association and preconscious information processing.

The two systems interact with each other, and the quality of information processing is influenced by both environmental and individual factors as well (Bognár & Orosz, 2014; Epstein, 2010; Epstein, Pacini, Denes-Raj & Heier, 1994).

### *Emotionality*

Emotionality was assessed through the specific subscale of the HEXACO-60 (Ashton & Lee, 2009). Out of the 6 HEXACO personality factors only emotionality (e.g., "I worry a lot less than most people do.", "Even in an emergency I wouldn't feel like panicking.") was measured, and it showed a good reliability level, with a Cronbach's Alpha coefficient of 0.72.

### *Self-efficacy*

The General Self-Efficacy Scale is a 10 item, self-report measure with a single scale of general self-efficacy (e.g., "I can always manage to solve difficult problems if I try hard enough.", "I can solve most problems if I invest the necessary effort.") was used for the assessment of general self-efficacy. (Kopp, Schwarzer & Jerusalem, 1995). Based on the reliability analysis the General Self-Efficacy Scale in the present study has a Cronbach's Alpha coefficient of 0.87, which implies a strong internal consistency.

## PROCEDURE AND DATA ANALYSIS

A cross sectional explorational study has been carried out starting from January 2022 until February 2023. Romanian and Hungarian chess player clubs were contacted, and the survey was distributed electronically. All data was gathered and stored anonymously. Data gathering took place also on different social media platforms, via snowball method, by distributing an online Google Forms survey. The survey contained a detailed informed consent, which included that all participants must be over 18 and that the obtained data will be processed and stored anonymously. Furthermore, the survey consisted of a demographic questionnaire, the Rational Experiential Inventory, the Emotionality Scale of HEXACO-60 and finally the General Self-Efficacy Scale. Completion of the survey took 15-20 minutes.

### *ELO rating and Chess Expertise*

Expert chess performance can be objectively measured in ELO scores (Élő, 1978). Above-average ELO score is a correlation of high degree chess expertise (Gobet & Ereku, 2016). The difference in expert chess performance between A-category and master-level players was more evident when the number of steps to keep in mind increased and the game became deeper (Campitelli & Gobet, 2005). This is the reason for which we divided the participants into two groups, namely the A level ranking (1800 +ELO) and below. All participants needed to have an official ELO ranking from former games.

### *Data screening*

To prepare the data file and to run the statistical analysis the authors used IBM SPSS (Statistical Package for the Social Sciences) Statistics software, version 20. The preliminary analysis was based on Pallant (2016). The data

screening showed no missing cases in the database. The authors assessed normality with a split file method based on the two groups of chess players. Skewness and kurtosis values fall between -1.15 and .715 which imply that our sample is normally distributed, (Tabachnik & Fidell, 2013) which is supported by the 5% Trimmed Mean value and the Kolmogorov-Smirnov and Shapiro-Wilk normality tests' non-significant results.

### *Data analysis*

First, descriptive analysis was conducted for both continuous and categorical variables (data is shown in Table 1.), then we calculated Cronbach Alpha's values for every scale presented before, with the aim to assess internal consistency. By using the Independent Sample T-test, we made sure that there is a significant correlation between our main variables. The authors included some of these variables based on previous literature, while the inclusion of others has explorational purposes. The significance of these variables was analyzed by using binary logistic regression, including the two previously presented groups of chess players as dummy variables. The variables included in the model are: age, gender and practice hours are emotionality, rational and intuitive thinking, and general self-efficacy scores. The model includes unstandardized regression coefficients (B), standard errors (S.E.), Wald statistics, odds ratios [Exp(B)], confidence intervals and Nagelkerke $R^2$ values.

## RESULTS

Binary logistic regression was performed to examine the impact of emotionality, the nature of informational processing style and self-efficacy on the level of chess expertise. The created model consists of seven independent variables and one dependent variable. The two groups of chess players were divided based on their ELO rating, which is an indicator of skills level and expertise – we used this dichotomous variable as our dependent variable in the model. Based on previous literature, age, gender, and practice hours are also included in the model, simultaneously with emotionality, rational thinking, intuitive thinking, and self-efficacy scores. Results of the binary logistic regression analysis are presented in Table 2.

**Table 2.** Binary logistic regression analysis on chess expertise, emotionality, rational and intuitive thinking, and self-efficacy

| | Model 1 | | | Model 2 | | |
|---|---|---|---|---|---|---|
| | B | Exp(B) | S.E. | B | Exp(B) | S.E. |
| Age | .03 | 1.031 | .026 | .092 | 1.096 | .041 |
| Gender | -.739 | .478 | .657 | -1.358 | .257 | .952 |
| Practice hours | .349* | 1.417* | .084 | .442* | 1.555* | .111 |
| Emotionality | | | | 1.158 | 3.184 | .944 |
| Rational thinking | | | | 4.143* | 63.02* | 1.297 |
| Intuitive thinking | | | | .125 | 1.133 | .873 |
| General self-efficacy | | | | -.039 | .961 | .131 |
| Nagelkerke $R^2$ | 0.59 | | | .73 | | |

N = 90. In Model 1 we entered control variables such as age, gender and weekly practice hours at the time of the highest ELO score. In Model 2 appear emotionality, rational thinking, intuitive thinking and general self-efficacy as predictor variables for level of chess expertise. *p ≤ .001, Statistically significant results are marked with bold fonts and stars.

The analyzed model, according to Nagelkerke $R^2$ value, explains 73% of the variance in chess expertise. Statistically significant contribution was detected in case of practice hours ($p < .001$), and rational informational processing style ($p < .001$). Rational thinking turned out to be the stronger predictor variable of the model with an odds ratio of 63.02, followed up by practice hours with an odds ratio of 1.55. In the case of age, gender, emotionality and self-efficacy no meaningful results were present.

## DISCUSSION AND CONCLUSIONS

The objective of this study was to investigate the factors that can predict advanced chess competence and expertise, specifically achieving a performance level of A class or higher. Our findings indicated that the logical thinking style, and the number of practice hours of the participants were the only statistically meaningful determinants of chess skill and performance expressed in ELO rating (1800+ ELO). The findings align with previous research that highlights the significance of deliberate practice and learning in relation to ELO rating (Charness et al., 2005; Bilalic et al., 2008, Gobet & Charness, 2006). Prior research has consistently highlighted the significant role of practice and learning hours in determining success in chess contests (Howard's, 2011; Charness et al., 2005; Li et al., 2015). Our findings indicate that the amount of practice hours have a positive and statistically significant impact on the likelihood of achieving a higher ELO rating (A class or above).

Previous research has extensively examined intuition and rational thinking styles and indicated that both are crucial factors in the performance of chess players (Dreyfus & Dreyfus, 1986; Kahneman & Frederick, 2005; Moxley et al., 2012). Our investigation found that the rational thinking style was the only predictor that had a statistically meaningful impact and increased the likelihood of achieving an A-class result by up to 63 times, in the case of the best performance ever registered. The study did not find any evidence to support the predictive role of intuitive thinking style on chess expertise. This finding contradicts previous research by Glöckner and Witteman (2010) and Betsch and Glöckner (2010), who suggested that intuitive thinking style could be a substantial predictor of high performance in chess play. In contrast to the findings of Allen et al. (2011) and Bilalić et al. (2008), the role of emotionality in predicting advanced chess performance was not identified. Contrary to prior research by Jianguo et al. (2018), self-efficacy did not serve as a predictor of A-class or higher performance in relation to the best ELO rating achieved in this sample. The possible explanation of our results can be that chess mastery and performance require a significant level of focus, heightened attentional capacity, and the refinement of gameplay tactics through error correction. This is accomplished by analyzing previous matches and expanding one's theoretical knowledge base, encompassing openings, middle, and endgame techniques, as well as strategic mastery. The rationality and analytical approach exhibit the highest level of predictability on ELO rating above 1800, even when including other previously significant psychological predictors such as self-efficacy and emotionality. The reason for this phenomenon can be attributed to the significant demand for strategic thinking and systematic analysis by players

(Bilalic et al., 2008; Charness, 1981). Additionally, players must possess cognitive reflection and employ planned actions in order to achieve success or emerge as winners in complex games (de Groot, 1978; Ericsson & Charness, 1994; Cumming et al., 2005; Gobet & Charness, 2006) (Campitelli & Gobet, 2005). The outcome is also consistent with neuropsychological findings that emphasize the significance of analytical cognitive processes in chess playing and expertise (Villafaina et al., 2021; Saarilouma et al., 2004). The absence of significance in the predictive role of self-efficacy may be attributed to the assessment scale's characteristics, which primarily evaluated general self-efficacy and may have a low sensitivity in detecting the variability among A+ level chess players. Regarding emotionality, the absence of noteworthy findings could be attributed to the large proportion of male participants in the study's sample, who typically present lower rates of emotional reactions (Ramirez et al., 2024).The conclusion of the present study is that to obtain at least an A class level ELO rating, chess players will present a strong preference for rational thinking style, which is based on reasoning, uses higher-level cognitive processes and searches for the answer through analysis. Furthermore, the intentionally dedicated hours spent training and the knowledge acquired over the course of several years will greatly enhance one's experience and chess expertise.

## LIMITATIONS AND FUTURE DIRECTIONS

In addition to the findings that enhance the existing body of knowledge about skilled chess players, it is important to acknowledge also the limitations that should be disclosed. The study was a cross-sectional, single-point measurement study and did not yield data regarding changes in the evaluated variables. The data was collected through self-reported surveys, which have the potential for bias. However, there were no measures in place to assess social desirability and screen for biased responses. The recruitment primarily utilized the convenience sampling strategy, which may not be appropriate for detecting small effect sizes due to the limited population size. The sample exhibits a lack of female representation, which can be attributed to the predominantly male-dominated nature of the chess sector. Furthermore, gaining access to highly skilled female players is particularly challenging. An effective resolution to the aforementioned issue would involve adopting a gender-specific methodology in chess research. Moreover, it is important to take into account the influence of cultural practices, norms, and gender roles on many psychological factors. Future research should prioritize the investigation of blitz chess games to examine the impact of intuitive thinking style on chess expertise. Additionally, to evaluate high-level performance-related self-efficacy or chess self-efficacy,

future studies may employ a more narrowly focused scale to measure self-efficacy. Further research may also consider replacing the assessment scale of the emotional component of personality with one that focuses more on neuroticism, which has been demonstrated to be more sensitive in identifying emotional traits that may hinder chess or athletic performance. These modifications have the potential to clarify some of the variables that the current research found to be statistically insignificant as predictors of high performance in chess.

### *Statements and Declarations*

***Data Availability Statement.*** The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at: https://doi.org/10.6084/m9.figshare.22186144.v1

***Ethics Statement.*** The studies involving human participants were reviewed and approved by the Ethical Committee of Babes-Bolyai University (reference number 227/03.03.2023. Research Project: The Role of Emotionality, Self-efficacy, Rational- and Intuitive-Thinking in Chess Expertise). The patients/participants provided their written informed consent to participate in this study.

***Author Contributions.*** A.V., E.E.M. planning and conducting the research, A.V. recruiting participants, A.V., E.E.M. statistical analysis of data, A.V. writing up the results and procedure, E.E.M. writing the first version of the introduction and discussion, A.V., E.E.M. manuscript revision, and both authors approved the submitted version.

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