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Ability and non-ability traits in chess skill

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ABSTRACT

Chess is an appropriate model to study ability and non-ability traits as related with performance because it bears intellectual and emotional demanding requirements. With a group of amateur chess players (n = 100), the current study addressed two interrelated aims. First, we assessed whether the three broad PEN personality factors (psychoticism, extraversion, and neuroticism), and emotion regulation traits (cognitive reappraisal and expressive suppression) differentiated chess players from the general population. Second, we compared the association of domain knowledge and personality/emotion traits with chess skill. The main findings indicated that chess players scored lower in neuroticism and higher in expressive suppression compared with the general population. Moreover, chess knowledge related in a greater extent with chess skill than personality/emotion regulation traits, even though extraversion explained additional variability in chess skill. Overall, the findings suggest that non-ability traits may be influential in the selection of the chess environment. Besides, the findings corroborate the stronger impact of cognitive ability than personality traits on intellectual performance found in other domains.

1. Introduction

Chess is a robust environment to study individual differences in ability and non-ability traits related with performance. Chess entails intellectual and emotional taxing demands (Avni et al., 1990), with early studies suggesting that, apart from ability, the personality of chess players may determine diverse chess playing styles and thinking methods while contributing in addition to overall performance (Cleveland, 1907; de Groot, 1965). Moreover, the Elo chess rating that amateur and professional players hold is a useful indicator of individual differences in chess skill (Elo, 1978; Glickman, 1995). When compared with other fields of human activity, however, only a few studies have addressed the personality of chess players.

One of the first studies in this field reports findings with the Myers-Briggs Type Indicator (MBTI) from over four hundred US chess players (Kelly, 1985). This study indicates that chess players are more introverted and intuitive compared with the general population, and that master chess players are more intuitive than average players are. Another study compares the scores in four scales of the Minnesota Multiphasic Personality Inventory (MMPI) from competitive and average chess players, and non-players from Israel (Avni et al., 1987). Competitive players score higher than non-players do in suspiciousness, unconventional thinking, and orderliness, albeit with similar scores regarding neuroticism, aggression, or hostility. The unconventional thinking of chess players is additionally supported by higher scorers in the Sensation Seeking Scale (SSS) being more attracted to chess (Joireman et al., 2002).

Latter studies address individual differences in the personality of chess players at varying levels of skill. For example, lower scores in agreeableness, higher scores in extraversion, and higher scores in openness to experience relate with a higher involvement in chess of ten years old children (Bilalic et al., 2007b). Further findings with chess players at different ages highlight that low achievement motivation underlies domain withdrawal (de Bruin et al., 2007), and that the NEO-Five-Factor-Inventory (NEO-FFI) personality traits have a null influence on chess performance (Grabner et al., 2007). Findings from sixty German elite players with the Freiburg Personality Inventory – Revised (FPI-R) indicate that the personality of male chess players is analogue to the personality of the general population, whereas female chess players score higher in life satisfaction and achievement orientation, but lower in somatic complaints (Vollstädt-Klein et al., 2010). In addition, stronger male chess players appear as more introverted and less stressed than

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weaker male chess players, whereas stronger female chess players are more extraverted, less inhibited, and less aggressive than weaker female chess players are.

In the light of these findings, traits such as intuition, unconventional thinking, aggression, openness, extraversion, or emotional expressiveness, are apparently suitable for the requirements elicited during chess playing. To the best of our knowledge, however, the personality of chess players has never been studied with the three broad factors from the influential PEN model, psychoticism, extraversion, and neuroticism (Eysenck & Eysenck, 1985). Extraversion and neuroticism relate with the performance in tasks that imply skills useful for chess playing (Cox-Fuenzalida et al., 2006; Cox-Fuenzalida et al., 2003; Matthews & Gilliland, 1999). For example, extraversion is likely to enhance performance with stimulating conditions, whereas neuroticism is detrimental in tasks implying attention and stressful conditions. Hence, higher levels of extraversion and lower levels of neuroticism could contribute to a greater concentration ability and resistance to fatigue and stress during chess playing. On the other hand, higher scores in psychoticism tend to associate with a higher level of aggressiveness, which may be also influential in a competitive and warlike game such as chess (Bilalic et al., 2007b; Mazur et al., 1992).

Individual differences in personality relate as well with the modulation of emotion (Hamann & Canli, 2004), while bearing notable links with chess performance. Emotion regulation describes the experience and expression of emotions according with two main kinds of strategies associated with either the antecedents (reappraisal) or responses (suppression) to emotion eliciting situations (Gross, 2001; Gross & John, 2003). In this view, reappraisal focus on re-evaluating an emotion evoking situation to decrease its potential emotional burden, whereas suppression focus on the course of an active emotion to inhibit its behavioural expression. Emotion regulation conveys affective, social, and cognitive consequences (Gross, 2001), which may influence some circumstances during chess playing such as time trouble, the characterization of the opponent, or the management of wins and defeats (Krogius, 1976). To the best of our knowledge, however, evidence about the impact of emotion regulation on chess performance is rather sparse, with just a single study highlighting a robust positive link with the control over emotional expression in adult chess players (Grabner et al., 2007).

Domain knowledge is another key determinant of successful performance in several applied fields (Ackerman, 1996, 2000), including chess. Chess knowledge comprehends several facets of the game, such as memory about chess patterns (Gobet, 1998), the selection of the best chess moves (Calderwood et al., 1988), or verbal memory and processing (Holding, 1992). In chess, a highly specialized domain knowledge differentiates very well between expert and amateur chess players (Blanch, 2021; Blanch et al., 2020; Holding, 1992; Pfau & Murphy, 1988). As in other domains of intellectual activity, chess knowledge is gained through intensive practice and deep study over time (Campitelli & Gobet, 2008). Hence, the higher involvement of expert players in chess playing and study leads to a greater domain knowledge, while accounting for a remarkable advantage in objective chess skill over amateur players (Blanch, 2018; Campitelli & Gobet, 2011; Grabner et al., 2007; Howard, 2012). Domain knowledge is, therefore, one of the most consistent predictors of chess skill.

The competitive domain of chess is intellectually and emotionally awkward. Hence, both ability and non-ability traits could associate in different degrees with chess performance. Whereas domain knowledge is a robust predictor of chess skill, the association of non-ability traits with chess skill is rather unknown, particularly concerning the broad personality factors from the PEN model and emotion regulation. The aim of this study was two folded. First, we asked whether chess players differ from the general population concerning the psychometric scores in psychoticism, extraversion, neuroticism, and emotion regulation. We expected higher scores for chess players in psychoticism, extraversion, and emotion regulation, and lower or similar scores in neuroticism. Second, we contrasted whether personality and emotion regulation, explained additional variability in chess skill over and above domain knowledge. We expected a stronger association of domain knowledge than personality and emotional regulation traits on chess skill. We expected, however, that higher levels of psychoticism and extraversion, lower levels of neuroticism, and a higher level of emotion regulation could also bear positive associations with chess skill.

2. Method

2.1. Participants

There were 100 chess players (3 females) with an average age of 41 years old ($Sd = 15$). Age ranged between 18 and 71 years old. All players were registered in the Catalan Chess Federation. All players were involved in chess clubs and in regular chess contests. The mean Elo rating of this group was of 1934 Catalan Elo points ($Sd = 155$), ranging from 1687 to 2311 points (Elo, 1978; Glickman, 1995).

3. Measures

3.1. Verbal chess knowledge

A questionnaire with 15 four-choice items was used to tap verbal chess knowledge (Van der Maas & Wagenmakers, 2005). Five items asked about the openings, middle game, and endgame, which are the three main consecutive typical stages of a chess game. There was a maximum time to complete each item of 15 s. The Cronbach's alpha reliability for these three components and for the whole test was below 0.55. These measures of performance, however, are likely to vary notably across different levels of the evaluated latent trait according with item response theory (Hambleton et al., 2000). Hence, a component and test information function indicated a lower reliability at one standard deviation below the mean trait level, with a steep increment above that point. Across eleven trait level points, the openings component was the least reliable (from 0.34 to 0.79) and the middle game component was the most reliable (from 0.36 to 1.11), with the endgame (from 0.30 to 0.99) and the total test score (from 0.33 to 0.95) lying somewhere in between (Fig. 1S, supplementary material).

3.2. Personality

We administered the Eysenck Personality Questionnaire (EPQ), an 83-item questionnaire with a dichotomous 'true-false' response format tapping extraversion, neuroticism, and psychoticism (Eysenck & Eysenck, 1984). Extraversion characterizes the interest in external or internal processes, with higher scores being indicative of a higher focus in the outer world of people and things. Neuroticism measures emotional tone, with higher scores characterizing emotional instability and insecurity. Psychoticism measures tough-mindedness, with higher scores characterizing impulsive and aggressive behaviour. The Cronbach's alpha reliabilities with the present sample were 0.76 for extraversion, 0.87 for neuroticism, and 0.67 for psychoticism.

3.3. Emotion regulation

Emotion regulation was measured with a Spanish adaptation of the Emotion Regulation Questionnaire (Gross & John, 2003). This 10-item instrument comprises six items tapping cognitive reappraisal, a form of reshaping and modifying the impact of an emotional reaction (*When I want to feel less negative emotion, I change the way I'm thinking about the situation*). Besides, four items tap expressive suppression, a form of response modulation that inhibits the behavioural expression of emotions (*When I am feeling negative emotions, I make sure not to express them*). All items are scored from 1 (strongly disagree) to 7 (strongly agree). Higher scores in cognitive reappraisal indicate a higher disposition to

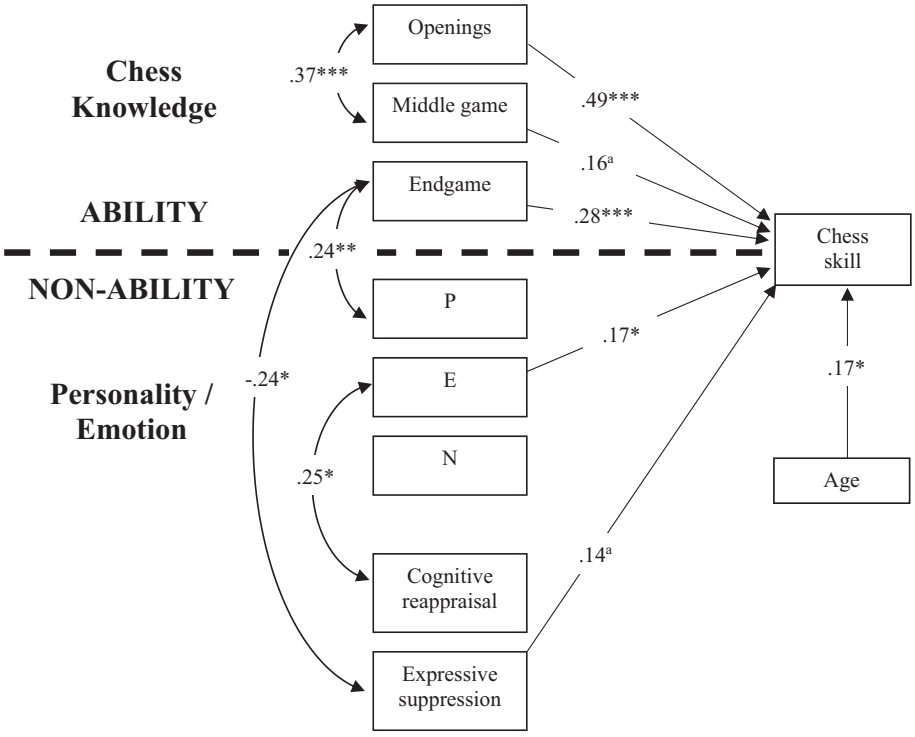

Fig. 1. The path analysis shows the statistically significant links between knowledge (openings, positional, endgame), and personality/emotional regulation (psychoticism, extraversion, neuroticism, cognitive reappraisal, and expressive suppression), with chess skill ($^{a}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$).

modify emotional reactions early when elicited. Higher scores in expressive suppression indicate a higher disposition to modify behavioural expressions of emotional reactions when elicited. The Cronbach's alpha reliability in this sample was 0.43 for cognitive reappraisal and 0.71 for expressive suppression.

3.4. Chess skill

The Elo rating is a reliable and accurate measure of chess skill. Higher scores in the Elo ratin denote a higher level of chess skill (Elo, 1978; Glickman, 1995). In the current study, we used the Catalan Elo rating from each player on the season in which the data was collected.

3.5. Procedure and statistical analyses

Participants were informed about the purpose of the study and signed an informed consent form. The study complied with the ethical regulations of our University.

Participants responded to the questionnaires after playing an official chess game organized by the Catalan Chess Federation in different locations of Catalonia, from November 2015 until April 2016. There was no reward for participating in the study.

We conducted *t*-tests to compare the personality and emotion regulation measures of the current sample with normative data. Because mainly males composed the current sample, we used the full sample sizes of the normative data (see Table 1). The personality measures were contrasted with the norms for the general population provided in the Spanish language manual of the EPQ (Eysenck & Eysenck, 1984). The emotion regulation measures were contrasted with the normative data from a sample of undergraduate students (Gross & John, 2003). We computed the effect sizes and Bayes factors of each comparison. Values of 0.8, 0.5, and 0.2 denote large, medium, and small effect sizes, respectively (Cohen, 1988). The Bayes factor indicates the likelihood of the data supporting the null hypothesis relative to the alternative hypothesis. Higher values provide a stronger support for the alternative hypothesis, whereas lower values provide a stronger support for the null hypothesis (Wetzels et al., 2011).

Besides, we specified a path analysis to contrast the association of ability and non-ability traits with chess skill. This approach allowed evaluating the simultaneous associations of both kinds of traits with chess skill, and the specification of correlations between the intervening variables (Bollen, 1989). Age, the verbal chess knowledge components (openings, middle game, and endgame), personality, and emotion regulation were the predictors, and the chess skill measure was the

Table 1
Comparison of personality and emotional regulation in chess players and in the general population (Sample size for the normative data $n^{a} = 527$, $n^{b} = 1483$). The Bayes factor was obtained with the ttestBF function from the BayesFactor R package.

	General population		Chess players		Group comparisons		
Trait	M	Sd	M	Sd	*t*	Cohen's d [95%CI]	Bayes Factor
Extraversion[a]	12.74	4.13	10.76	4.34	4.36***	0.48 [0.26, 0.69]	6.91
Neuroticism[a]	12.2	5.42	9.12	5.57	5.19***	0.57 [0.35, 0.78]	12.52
Psychoticism[a]	6.09	3.58	4.98	3.18	2.89**	0.32 [0.1, 0.53]	1.87
Cognitive reappraisal[b]	4.60	0.94	4.49	0.78	1.14	0.12 [−0.08, 0.32]	-1.44
Expressive suppression[b]	3.64	1.11	4.51	1.24	7.53***	0.78 [0.81, 0.41]	24.94

** $p < 0.01$.
*** $p < 0.001$.

dependent variable. The model evaluation was conducted with the comparative fit index (CFI), the Tucker-Lewis Index (TLI), and the root mean square error of approximation (RMSEA). The criteria for a good fit to the data were CFI and TLI values closer to one, and a RMSEA below 0.09 (Hu & Bentler, 1999).

All statistical analyses were conducted with the R software (R Development Core Team, 2014; Rosseel, 2012). The data set and code used in this study is available on request to the corresponding author.

4. Results

4.1. Comparison between chess players with normative data

Table 1 shows the comparison of the personality and emotion regulation variables between chess players and the normative data. The group of chess players showed lower average scores in all variables except for expressive suppression. The *t*-tests yielded significant differences in all variables but for cognitive reappraisal. The effect sizes ranged from small for cognitive reappraisal ($d = 0.12$), small to medium for psychoticism ($d = 0.32$) and extraversion ($d = 0.48$), medium for neuroticism ($d = 0.57$), and close to large for expressive suppression ($d = 0.78$). The last column in Table 1 displays the Bayes factor for each contrast, with the lowest values for cognitive reappraisal ($B = -1.44$), and psychoticism ($B = 1.87$), a medium value for extraversion ($B = 6.91$), and the largest values for neuroticism ($B = 12.52$) and expressive suppression ($B = 24.94$). There were null differences for cognitive reappraisal, weak differences for extraversion and psychoticism, and the most robust differences for expressive suppression and neuroticism. Fig. 2S in the supplementary material displays the relationship between the effect size and the Bayes factor for these findings.

4.2. Associations with chess skill

There were consistent Pearson's correlations between the chess knowledge variables (openings, middle game, and endgame) with chess skill. Conversely, the personality and emotion regulation variables were uncorrelated with chess skill (Table 1S in supplementary material). Fig. 1 shows the path analyses relating age, chess knowledge, and personality/emotion, with chess skill. This model yielded a non-significant chi-square value (35.8, $df = 31$, $p = 0.254$), with fit indices suggesting an overall good fit to the observed data: CFI = 0.945, TLI = 0.920, and RMSEA = 0.040 (90% CI = 0.000, 0.087). The coefficient of determination was $R^2 = 0.44$.

There was a positive association of age with chess skill (0.17, $p < 0.05$), indicating that older players had a higher level of chess skill. Moreover and as expected, chess skill was mainly associated with chess knowledge about the openings and endgame components, whereas the association of knowledge about middle game with chess skill was rather weak (0.16, $p < 0.10$). There was, in addition a statistical significant association between extraversion with chess skill (0.17, $p < 0.05$), and a weaker association between expressive suppression with chess skill (0.14, $p < 0.10$). Removing these two latter paths worsened the model fit (41.8, $df = 33$, $p = 0.141$; CFI = 0.900, TLI = 0.864, and RMSEA = 0.052 (90% CI = 0.000, 0.096)), and yielded a lower coefficient of determination for chess skill ($R^2 = 0.40$), suggesting that extraversion contributed to explain further variance in chess skill.

5. Discussion

This study addressed ability and non-ability traits with a sample of amateur chess players in the taxing environment of chess playing. We compared the personality traits and emotion regulation strategies of a group of chess players with normative data. Besides, we compared the relative association of domain knowledge and personality/emotion regulation traits with chess skill.

When comparing the non-professional sample of chess players with the available normative data, the stronger support for inter-group differences arose for neuroticism and expressive suppression. These findings underline that a higher emotional stability and the ability to manage emotions differentiated chess players from the general population, somehow as suggested elsewhere concerning similar traits (Avni et al., 1987; Joireman et al., 2002; Krogius, 1976). A good level of emotional stability could indeed contribute to a better adaptation to the chess-playing environment by increasing attention, concentration, and coping with fatigue (Cox-Fuenzalida et al., 2003), bearing in mind that chess playing circumstances change continuously during the course of a chess game. Moreover, suppressing the expression of emotions could be indeed useful to modulate the expenditure of thinking energy and fatigue, to improving playing style and to conceal negative emotions when for instance making an unrecoverable playing mistake, or when occasional game weaknesses arise during a chess game (Krogius, 1976). The lower extraversion of chess players compared with the general population is also consistent with earlier findings (Kelly, 1985), even though the effect was only medium with the current data while the findings might not compare well because of the time span and the instruments used across both studies.

Succeeding in intellectual domains depends on ability and non-ability traits (Ackerman, 1996; Ackerman & Heggestad, 1997). The path analysis outcomes, however, indicated that chess knowledge, particularly about openings and endgames, were the stronger predictors of chess skill over and above personality and emotion regulation. The participants in the current study scoring higher in these specific verbal knowledge components also had the higher levels of chess skill as expected and corroborated past findings (Ackerman, 2000; Blanch et al., 2020; Gobet, 1998). The finding is in addition consistent with the reported discrepancies in chess skill at varying levels of verbal chess knowledge (Holding, 1992; Pfau & Murphy, 1988). Moreover, that chess knowledge is obtained with chess practice and study throughout relatively long periods (Campitelli & Gobet, 2008), was also substantiated by the statistical significant positive association between age and chess skill. In contrast, neuroticism and expressive suppression were unrelated or marginally related with chess skill, whereas extraversion associated positively with chess skill. This finding is consistent with the efficient performance of extraverts in stimulating conditions (Matthews & Gilliland, 1999). Nonetheless, extraverts have shown a higher decrement in correct responses compared with introverts in a vigilance task attributed to the lower level of arousal in extraverts (Cox-Fuenzalida et al., 2006). This relationship, however, could be false for long-term measures of performance (i.e., Elo rating) in more stimulating tasks such as chess playing.

It could be argued that the association of personality and emotion regulation on chess performance may be indirect through either ability traits or practice and training activities as highlighted elsewhere (de Bruin et al., 2007). Meaningful effects of non-ability traits on performance are common in other intellectual domains such as in learning and academic achievement in formal education, even though ability traits reflect an overall more consistent impact on performance (Beier et al., 2010; Blanch & Aluja, 2013; Dumfart & Neubauer, 2016). The domain of chess is particularly appropriate to address the role of ability and non-ability traits in performance, because it bears noteworthy taxing intellectual and emotional demands. Cognitive ability traits contribute to partly explain individual differences in chess performance (Bilalic et al., 2007a; Blanch et al., 2017; Burgoyne et al., 2016). Non-ability traits have been much less studied in this specific domain, however, although the current findings suggest that extraversion contributed in addition to explain the variability in chess performance (Krogius, 1976; Matthews & Gilliland, 1999).

A limitation in the current study was the reduced sample size and a sample composition constrained to amateur chess players. Data from expert chess players might show different outcomes because of their higher involvement and exceptional performance in the domain (Blanch, 2018; Vollstädt-Klein et al., 2010). Moreover, the links amongst

ability and non-ability traits in predicting performance are complex because of being moderated by other factors such as age and sex (Ackerman & Heggestad, 1997). These factors have been also identified in the chess domain. For example, individual differences in skill and in the involvement and persistence in the domain, have been frequently reported regarding age and sex (Blanch, 2016; Blanch et al., 2015; Gobet & Campitelli, 2007; Howard, 2014). Hence, such links should be evaluated with larger sample sizes than that used in the current study. The male to female ratio was very high in the current sample (32:1). This unbalanced representation of females is recurrent in the chess domain, which rendered an additional comparison based on sex as inappropriate with the current data (Bilalic et al., 2009; Blanch, 2016; Howard, 2014).

This study examined for the first time the broad personality factors from the PEN model with an amateur club-level sample of chess players (Eysenck & Eysenck, 1985). Neuroticism and emotional expressive suppression scores differed between chess players and the general population. Higher extraversion scores associated with a higher chess performance. The main findings, however, corroborated the stronger association of ability on performance compared with non-ability traits, even though non-ability traits such as extraversion and expressive suppression could also play a role in the domain of chess.

CRediT authorship contribution statement

Angel Blanch: Conceptualization, Writing – original draft, Writing – review & editing, Methodology, Software, Project administration. **Anton Llaveria:** Writing – review & editing, Data curation, Validation, Visualization.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.paid.2021.110909.

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