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Chess Player Expertise from a Micro-Phenomenological Perspective*

Experticia del ajedrecista desde una perspectiva microfenomenológica

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ABSTRACT

Different researches have addressed the phenomenon of how the chess player reaches a high level of expertise; however, most of them have been carried out from a third person perspective, that is, without taking into account the subjective experience of the chess player. The objectives of this paper are: 1) to analyze the expertise of proficient level chess players from a phenomenological perspective, that is, from the subjective experience of the player; 2) to point out the internal states that seem to be cognitively relevant in the actions of chess players; 3) to theorize about the eventual role that intuition plays in the actions of chess players. For this purpose, an exploratory study was carried out with five chess players during a national competition in Mexico, using the micro phenomenological interview method proposed by Claire Petitmengin. The results indicate that there are regularities in the players' internal states at intra- and interpersonal levels implicitly associated with critical moments of the games. This allows us to offer an operational definition of intuition and to affirm that it is indeed part of the cognitively relevant processes of proficient chess players, although their actions still depend, to a large extent, on the explicit calculations they perform during critical moments.

Keywords: chess; phenomenology; intuition; expertise; micro phenomenological interview.

RESUMEN

Diferentes investigaciones han abordado el fenómeno de cómo el jugador de ajedrez alcanza un nivel alto de experticia; sin embargo, la gran mayoría se han llevado a cabo desde una perspectiva en tercera persona, es decir, sin tomar en cuenta la experiencia subjetiva del ajedrecista. El presente trabajo tiene como objetivos: 1) analizar la experticia de ajedrecistas de nivel proficiente desde una perspectiva fenomenológica, esto es, desde la experiencia subjetiva del jugador; 2) señalar los estados internos que parecen ser cognitivamente relevantes en las acciones de los ajedrecistas; 3) teorizar sobre el eventual papel que juega la intuición en las acciones de los jugadores de ajedrez. Para ello se realizó un estudio

exploratorio con cinco jugadores de ajedrez durante una competencia de corte nacional en México, utilizando como método la entrevista microfenomenológica propuesta por Claire Petitmengin. Los resultados indican que hay regularidades en los estados internos de los jugadores a nivel intra e interpersonal asociadas implícitamente a momentos críticos de las partidas. Lo anterior permite ofrecer una definición operacional de la intuición y afirmar que esta, en efecto, forma parte de los procesos cognitivamente relevantes de los ajedrecistas de nivel proficiente, aunque las acciones de estos aún dependen, en buena medida, de los cálculos explícitos que realizan durante los momentos críticos.

Keywords: ajedrez; fenomenología; intuición; experticia; entrevista microfenomenológica.

1. Introduction[1]

The emergence of the artificial intelligence called AlphaZero in 2017 in the field of artificial intelligence came to revolutionize the idea of how chess is played. This program learned in only four hours to play by itself, defeating the best chess engine in the world, the software called Stockfish, which played at a higher level than the world chess champion at the time. AlphaZero showed a strange way of selecting moves, making inexplicable decisions, for example, sacrificing pieces at the start of a game with no apparent medium-term gain (Bratko 2018). There was no competition for chess programs that used computational power at great speed and great depth until AlphaZero emerged, which does not have the raw power of the best chess programs, nor the depth in its calculations, i.e., its strength lies not in computation, but in learning itself by playing millions and millions of games with itself (Sadler & Regan 2019). The knowledge that this technology produced is, therefore, unique, and superior to what was previously available.

[1] This article is the result of a research for the master's degree in Cognitive Sciences at the Universidad Autónoma del Estado de Morelos, whose degree work is entitled: Expertise of the chess player from a phenomenological perspective (Astudillo Sandoval 2020).

Since the beginning of the computational era chess has played an important role in artificial intelligence, an example of this are the ideas of Alan Turing and Claude Shannon, both of whom understood that a simple algorithm could play chess competently (Sadler & Regan 2019). At the beginning of artificial intelligence, the processing power of computers was slow and the time when they would be able to beat the best human chess players was far off. This was changing with the advent of microchips, increased computational speed and brute force analysis. Years later, computers began to defeat humans as they could calculate millions of variants at a greater depth and in a few seconds; moreover, they could compare possible moves with millions and millions of real games played by humans throughout history (Kasparov 2017).

2. Background on the Cognitive Study of Chess

Chess has long been considered a small window into the thinking of human beings, that is, through the analysis of the decisions made on the board, one can understand more about the reasoning of each individual. In recent decades, research has been conducted on both the correlation between cognitive ability and chess skill (Burgoyne et al. 2016), the intellectual and socioemotional enrichment benefits (Aciego, García & Betancourt 2012), and the impact of chess instruction in education (Zeynalli 2015). There has also been research establishing a correlation between chess and mathematics (Trinchero 2013), highlighting studies such as that of Robbins et al. (1996) in which experiments were conducted to analyze the components of working memory (Baddeley 1983) in chess players of different skill levels.

The practice of chess is a highly complex cognitive task that has been studied for many years. In chess, the ability of the players is measured by means of the *rating* or *Elo*. The Elo system is a mathematical model based on a statistical calculation based on the games played by the chess player against other players. This system increases or decreases the rating of the player with respect to whether he wins or loses, which is modified in each official tournament in which he participates. This system

was developed by Professor Arpad Elo with the aim of defining the current strength of all chess players (Bueno 2015).

One of the earliest (and most celebrated) research done on expertise in the field of psychology was by Adriaan de Groot (2014), who conducted experiments with chess players of different skill levels. De Groot's first hypothesis was that expert players base their actions on a superior deep search on the different possible moves (calculating moves in advance). He compared the levels of deep search in various chess positions with players of different skill levels, however, he found no significant differences in performance. This chess master and psychologist believed that expert players based their actions on their greater ability to search deeply into the different variants presented to them. One of his experiments consisted of presenting the participants with a specific position on the chessboard for a few seconds and then removing it and asking them to reproduce it on another board. De Groot did another experiment by showing a real chess position on the board (a position from a game where some swaps were made, around 15-23 pieces on the board) for 5 seconds and then asked to play the same memorized position on another board. It was there that he found differences between expert, mid-level, and novice players. The expert players reproduced the chess positions almost with 100% accuracy and faster; the medium level players were less accurate and faster, while the lower-level players had many errors in reproducing the position and were also slower. De Groot concluded that the expertise of a chess player was based on the knowledge of patterns, i.e., structures learned during years of training that allow the most skilled players to select the best move quickly as opposed to less skilled players.

The first research that reinforced Adrian de Groot's theory was proposed by Chase and Simon (1973). Replicating De Groot's experiment, they found that the stronger players placed groups of pieces quickly, while the lower-level players placed piece by piece with no apparent grouping or relationship between them. In that work, Chase and Simon proposed the theory of *chunks*, which indicates that players encode most of their knowledge in long-term memory as *chunks*, which are perceptual units that can be treated as a whole.

The theory of *chunks* is one of the most accepted, however, there are studies with different positions, as is the case of the proposal of Holding (1992), who found that the highest level of expertise is based on the ability to search in different plays at a greater depth to produce better evaluations based on the acquired knowledge. Holding found that expert players calculated deeper in the search tree than weaker players and, in addition, found the best continuations in each resulting position.

Another study with a group of chess players found that expert players examined many more potential moves than weaker players; the maximum moves ahead were related to their rating, for example: a player with 2200 Elo calculated about twelve moves ahead (depth) and players with a rating of 1200 calculated only three moves in depth (Charness 1981).

2.1. Expertise

As mentioned, there are several controversies as to what defines the expertise of a chess player. Specifically, there are two major positions on which several researchers have taken sides: those who agree with the theory of *chunks* or patterns (experience) and, on the other hand, the theory of in-depth search capacity (reasoning). It is not only in chess that experts make complex and difficult decisions, but this also occurs in many different domains under conditions of uncertainty and time pressure. Experts may have superior analytical skills to generate and evaluate alternatives (search) or a very strong ability to recognize characteristic situations and promising options based on stored knowledge (pattern recognition) (Connors, Burns & Campitelli 2011).

Although both elements are undoubtedly essential, current theories place more emphasis on the role played by pattern recognition in expert decision making (Feltovich, Prietula & Ericsson 2006). While it is true that theories nowadays rely more on pattern recognition, the discussion is still open.

2.1.1. Model of dreyfus

One of the theories of expertise that refers to intuition as a fundamental part of the actions of people with greater ability was proposed by Hubert Dreyfus. According to the model proposed by Hubert Dreyfus in the book Mind over machine (2000), the way a skill is acquired in humans is generated through instructions and experience. It is worth mentioning that Dreyfus' theory refers to expertise in general; however, the model he proposes can serve as a frame of reference to interpret expertise in chess players. This model proposes a scale in which at the lowest level is the know-that, which in the game of chess would apply to the understanding and following of the rules of the game. Completely opposite to the lowest level, there is a level of expertise that Dreyfus called *know-how*, which is based on experience. This last level is reached after several stages in which the person generates the ability to develop a specific task in an assertive manner. Not all people reach an expert level in the skills they develop in their area of specialization; for example, in chess only a small percentage of beginners can become experts. This is one of the biggest questions in the field of expertise: What separates expert players from others? There are many factors that can influence this, for example, the hours of practice you put into the skill you are learning.

Dreyfus divides the process of skill acquisition into five stages of qualitatively different perceptions of the task and decision making as the skill improves. The five stages are: Beginner, advanced beginner, proficient, proficient, and expert.

2.1.1.1. Stage 1: Beginner

The first stage of the acquisition of a new skill is carried out by means of instructions, i.e., it is limited to following rules. The elements that are considered relevant to the situation are clear and objectively defined by the beginner and can even be recognized without reference to the entire situation in which they occur. Dreyfus defines such elements as "context-free rules".

Stage 2: Advanced beginner

Performance improves to a slightly acceptable level: once the person has considerable experience in dealing with real situations, the advanced beginner begins to recognize elements that cannot be defined in terms of context-free characteristics. The advanced beginner begins to recognize these elements when they are present because they perceive similarities with previous examples. These new elements are defined as "situational". However, the rules of behavior refer to context-free and situational components. At this stage, experience seems much more important than any form of verbal description.

Stage 3: Competent

Having gained more experience, the number of identifiable situational and context-free elements in real-world circumstances becomes overwhelming. At this stage, people are instructed on the range of options for addressing the objectives, although it has also been found that they adopt a hierarchical decision-making procedure on their own. Also, at this stage they begin to choose a plan to organize the situation, examining only the small sets of factors that are the most important according to the chosen plan. In this way, a person can both simplify and improve his performance. A competent chess player may decide, after studying a position and weighing alternatives, that he can attack his opponent's king. He will then ignore certain weaknesses in his own position and the personal losses created by his attack, while his main objective becomes to eliminate the pieces defending the enemy king.

Stage 4: proficient

Generally, the person who has reached this stage of proficiency is the one who is deeply involved in his or her task and experiences from a specific perspective certain salient feature of the situation, while other features are ignored. At this stage no objective decision or reflection occurs because the proficient person has experienced similar situations in the past, therefore, he/she associates this with present situations, plans that worked in the past and thus anticipates results that previously occurred. Dreyfus uses the term intuition as a synonym for *know-how.* Intuition is the prod-

uct of deep situational involvement and holistic discernment. The proficient person understands and intuitively organizes his task, but still thinks analytically about what to do; that is, he still relies on his calculation in critical situations or moments. The elements that are presented to him as important due to the experience he has acquired will be evaluated and combined with the rules to produce decisions on how to manipulate the environment in the best possible way. The proficient chess player can recognize -almost immediately and without making a conscious effort- a wide variety of moves because he has formed a wide repertoire of different types of positions. Under this strategy, he can calculate the move that best suits his intuitive plan, e.g., he knows he must attack but must reflect on the best way to do it.

Stage 5: Expert

An expert generally knows what to do based on his or her maturity and knowledge put into practice. Experts do not solve problems and do not make decisions when things develop in the normal way but do what normally works for them. Although it may seem that experts never reflect and are always right, it does not always work like that. Expert performance is constant and non-reflective, but when time permits and the outcome is crucial, an expert will reflect before acting. Chess grandmasters, absorbed in the game, can completely cease to be aware that they are manipulating pieces on the board and see themselves more as participants in a world of opportunities, threats, strengths, weaknesses, expectations, and fears: They have a great ability to discriminate an immense number of situations acquired by experience. It has been estimated that a chess grandmaster can recognize about 50,000 types of positions (Gobet 2018) and, for him, a desirable tactic or move is something obvious. Expert chess players can play a move between five and ten seconds, and even faster without serious degradation of their performance. At that speed they rely almost entirely on their intuition (more on this later), and almost nothing on alternative comparison and analysis. According to this five-stage model presented by Dreyfus and Dreyfus (1986), interpretation, whether conscious or not -as in the case of the competent player- or non-conscious and based on holistic discrimination -as in the case of experts- determines what is highlighted as most important in a situation: the

interpretive skill that constitutes the "judgment". However, in the first two stages of skill acquisition (beginner and advanced beginner) this judgment has not yet been developed, while in the proficient stage it is made in a reflexively conscious manner. In the last two stages (proficient and expert) judgments are made based on previous concrete experiences. The proficient level is just the stage where players still use their calculation to choose the best move, but know-how or intuition begins to present itself at critical moments.

Despite the above, there are positions that do not agree with the application of Dreyfus' model to chess expertise, an example of this are Montero and Evans (2011), who argue that the chess analogies used by Dreyfus in his theory are erroneous. The authors do not share the idea that a skilled chess player carries out his or her move execution in a non-reflective, efficient, and smooth manner. According to these authors, the moves of an expert player understood as intuitive are conceptual and rational. To prove their point, they conducted first-person interviews with expert players, who reported that their execution is based on a certain type of deliberation, which is common in chess. For them, this means that chess is rational from beginning to end. Finally, it is worth mentioning that there are works on the interesting McDowell-Dreyfus debate, such as the one presented by Schear (2013), in which they address, among other philosophical problems, precisely that of experience.

In view of the above, the research question of this paper was the following: in the context of chess players: what is intuition and what role does it play in the actions of proficient players?

The present work proposes a novel approach to learn about the player's second-person experience through a micro-phenomenological interview (Petitmengin 2006). The objective is to verify whether intuition is part of the cognitive processes of chess players at critical moments and, in turn, to determine how intuition develops in chess players at a proficient level. Knowing more about the cognitive processes of chess players during critical moments in a chess game will help to improve the training methods they use and, therefore, to optimize their skills.

3. Method

In the current study we worked with chess players who had a rating and skill level above 1900 Elo points and who were participating in an official tournament. The micro-phenomenological interview was used for data collection (*Ibid*.) with the purpose of getting to know both the subjective experience of the participants at a critical moment of the game, as well as the way in which their cognitive processes function during the game. This was a preliminary study with a cross-sectional exploratory design where the study subjects were not randomly selected. A singular experience of one game of each of them was investigated.

3.1. PARTICIPANTS

For this work we selected chess players of proficient level (Dreyfus, Dreyfus & Athanasiou 2000), which is equivalent to the rating indicated by the International Chess Federation (FIDE) and corresponds to the level that precedes the expert level (experts have more than 2200 Elo points). All the players in this study belong to the Mexican Chess Federation (FENAMAC) and have been participating in national tournaments for at least five years.

3.2. SAMPLE

The sample consisted of five chess players who had at least five years practicing this discipline, with a rating between 1900 and 2200 points. The average age was 17.4 years (SD = 1.1) and an average rating of 1952.6. Four of them are high school students, only one of them is an undergraduate. Four are male and one is female. Participants were from different parts of the Mexican Republic (Table 1). To respect the confidentiality of the participants, their names were omitted, and letters were assigned to refer to them. The project was approved in general by a research com-

mittee, which considered that the study participants did not run any risk with their participation and that there were no ethical implications.

Table 1. Sample of proficient level players

Participants	Rating	Age	Gender	Place of Origin
FTR	1915	16	Male	Durango
EGB	1926	19	Male	Morelos
JA	1981	17	Male	Guerrero
FR	2141	18	Male	Ciudad de México
PG	1900	17	Female	Edo. de México

3.3. Tool

The micro-phenomenological interview (Petitmengin 2006) was used to obtain data, which allowed access to the pre-reflective levels of the participants through different tools to maintain the subject's attentional focus on the constituent aspects of their experience, instead of their opinions and beliefs about it. In other words, one of the objectives of the micro-phenomenological approach is to redirect a person's attention from the content of his experience - which can vary indefinitely - to the experience of the content, in which stable aspects can be found and which generally remain in a pre-reflective dimension of the experience.

A prerequisite for conducting the micro-phenomenological interview is to guide the interviewee towards the evocation of a specific experience. In this way, the interview avoids describing the experience in general or in a depersonalized and abstract way and insists that the description of an evoked experience be concrete. Likewise, it avoids the description of beliefs or judgments related to the experience being studied, as well as the theoretical knowledge the person may have in relation to it, or

what Vermersch (2019) calls "satellite information" of the action. The evocation of the experience favors the description of the experience because the questions asked to the interviewee consider concrete aspects of the experience itself, avoiding the involvement of peripheral aspects that may detract from the evocation made by the participants of the study.

3.4. Procedure

An important aspect of the experiment was to carry it out within the context of the action of the players themselves, with the idea that the player's experience was that of a real competition situation and with all the variables that arise, such as stress due to the situations of the game itself, the pressure exerted by the opponent, the clock or the fatigue of maintaining attention for several hours of play. All the above can influence the player's performance during a competition.

To achieve the conditions, the research was carried out during a classical chess tournament (minimum 60 minutes per player). The micro-phenomenological interview was applied after a game, in which the player was asked to select a critical moment of the game. "Critical moment" is defined as a situation where different plans are presented, there are both many exchanges of pieces and various options for moves, initiatives and possible advantages, and conflict situations arise in which one must calculate in depth. These critical moments are of great importance due to the influence they have on the subsequent development of the game (Gaprindashvili 2013). In short, there are different possible modifications of strategic factors of different degrees. The level of expertise is based on being able to anticipate the modification of the hierarchy of strategic factors (Dorfman 2004); this is where intuition arises and where most of the mistakes are made in a game.

Once the player entered the evocation state, the temporal structure of the experience was explored. To achieve this, the following questions were asked: a) How did you sense that you were already in a winning position? b) how did you feel that stress? c) Where did you feel this relaxation? d) In which part of your body? e)

What happened before? f) What happened after? and g) And then? This gave the possibility to explore both the different sensations and emotions that were emerging within the critical moment in which the participants found themselves, as well as the cognitive strategies that proficient chess players use during that specific moment. This allowed us to obtain the necessary data to better understand how the players -who are in transition from the proficient stage to the expert level- carry out their movements and on what they base them. It also made it possible to understand the cognitive strategies used by the players.

Diachronic analysis was used to analyze the data (Petitmengin, Remillieux, & Valenzuela-Moguillansky 2018), which seeks to understand the temporal evolution of the described experience. For this purpose, the description of the experience was broken down into diachronic units organized hierarchically according to their level of detail or fragmentation. This allowed access to the knowledge of qualitative aspects of the critical moment related to the cognitive processes, emotions and bodily sensations that emerged.

4. Results: Analysis of the Micro-Phenomenological Interviews

4.1. Description of the interview analysis process

The first step after transcribing the player interviews was to perform data cleaning. At this stage, information that would be left out of the analysis was identified. The latter focused on the procedural description of the experience during the critical moment, leaving aside the players' beliefs, judgments, and concepts. This was done according to the technique described by Petitmengin (2006). It should be noted that there were no descriptions resulting from an inductive question by the interviewer, as they are considered suspicious and would probably have been discarded from the analysis. Once the different types of information provided by each of the

five interviewees were identified, the fragments related to the procedural dimension of the experience were selected, as shown in the case of JA (Table 2). Table 2 shows an example of some fragments where the different moments of the experience were separated, which contain the emotional sensations or actions that they carried out in the critical moment. The numbering of the column on the left-hand side serves to keep track of its original location in the entire interview, as this facilitates reference to the statement in later stages of the analysis.

Table 2. Interview excerpts from two participants

N.º	Interview excerpts
JA-51	"[…] Stressed and afraid of making a mistake in my calculation and subsequently losing the game, that's what made me take the risk but this one... I think I was going to feel unsatisfied for not having made that move and being able to win".
JA-75	"[...] Yes... Stressed and scared, but at the same time with a hope of being able to win".
JA-88	"[...] Because at the moment my opponent made that move, the traits that I noticed in my opponent, I saw him confident with security, but I did not know that two moves before I had calculated it... Because of that move he made I could win and that is what happened".
JA-160	"[...] I felt a little bit like I had the feeling that I already had a chance to win, to win a little bit easier, but when he made that play, I didn't lose my concentration".
JA-176	"First I focused and started to make in my mind a chessboard with the same position, but developing the moves in my brain, which over the course of the 15 to 20 minutes I could mmm, see what my player did in the game and that's what happened".
FTR-160	"[...] Because when one is... Concentrated you make, let's say, the moves, not the precise ones, but let's say, the most correct ones, and when you are concentrated and you lose concentration you lose the plans, the moves that could have won the game, which in this case was, but in other cases that have happened to me in other games when I am in the same position, mmm, I come out tying or losing with the game won".
FTR-269	"Yes, yes, one can tell from the physical aspect when a person is good or bad here. He feels here I'm going well, and a pitcher of cold water falls on him and changes his face completely".

In contrast, moments that do not pertain to procedural experience were discarded from the analysis, i.e., descriptions that refer to experiences "in general" or descriptions in which the interviewee appears through indefinite pronouns such as "one". An example of this is shown in Table 2 in two passages from FTR (excerpts 160 and 269 of the interview, respectively): "when one is concentrated" and "one can tell from the physical aspect when a person is good or bad here [...]", as the interviewee is not talking about the experience of the critical moment, but rather is mentioning a generalization or is talking about a past experience, but not about what he experienced at that moment.

The next step was to select the text in the form of utterances defined as pragmatically interpreted minimal linguistic units (Austin & Urmson 1990). For this purpose, the statements were organized according to the chronology of the experience since the chronology of the interview is not the same as the chronology of the experience. Subsequently, the description was reordered, i.e., the different moments of the experience were identified. "Moments" refers to an unspecific diachronic unit since it has neither a precise place in the sequence of experience nor a specific duration. For example, for the EGB participant (table 3), we see those statements 27, 31.1, 67.1, 67.3, 71.2, 71.3 and 79 were grouped as corresponding to the same moment. The numbers that appear with decimals are statements that were selected within that fragment, i.e., there may be several statements within the same fragment.

As can be seen, Table 3 represents a first process of identifying sentences belonging to the same moment in general, while Table 4 represents a finer selection to identify actions within the same moment, which is achieved after performing some interrogative iterations (this helps to obtain more fragmented diachronic units).

Table 3. EGB text selection to be analyzed

No.	Statement	Moment	Criterion	UDI
27.1	Nervous, I think it's the most nervous point. in which I am in the whole game	1	The statements talk about feeling nervous and excited	Nerves and excitement
27.2	When it comes to making the decision is an important decision especially at a critical point where the heart begins to beat the most	1		
31.1	I just feel my heart beating super fast	1		
67.1	Well, emotion	1		
67.3	I can take advantage then you are also excited at the same time	1		
71.2	I could not stop moving any part of my body such as my leg	1		
71.3	I was partly happy because I was able to ... I could make it win the game	1		
79	The leg, I always move my leg	1		
103	I'm telling myself how to: calm, calculate, you play well, you can see you can see deep	2	Statements talk about listening to your own voice	Listen to your voice
115	No no, my own voice	2		
119	I told myself: don't rush, you have a lot of time, invest it in this move because it won't be so difficult later on, so don't worry, think about it	2		
147	If it's like... it's a voice that I hear, my own voice telling me how to do it. think about whether to do it or not, but think carefully and that your decision is well founded	2		
263	Don't get excited, because you might not, think things through	2		
31	but I take a breath and concentrate on the position	3	The statements talk about concentrating	Concentrating
67.4	but you don't have to let that emotion or may those nerves this... be greater than your concentration	3		
103	then concentrate on seeing the position y no en que esa jugada puede ser muy buena	3		
203	Well, on the one hand, I feel relieved because I've already done it and I can't go back	4	The statements talk about feeling relaxed	Relaxation
243	so that makes me relax a little more because he's still having a hard time	4		
207	but, if it was true, I released a little stress, you know,	4		

To identify the moments, the list of selected statements was contrasted with the complete interview and a place was assigned to each of them in the temporal evolution of the experience. To group the statements related to a certain moment, certain indicators of temporality were found, such as actions, events, or linguistic markers This was followed by iterative questioning, i.e., the statements were interrogated to make the grouping criterion explicit. To this end, we ask ourselves: What makes us identify these statements as part of the same group? This process allows to confirm or modify the grouping made in the previous step. After the first interrogation, the process of grouping and interrogation was repeated to identify actions or events within the diachronic unit that indicated the presence of more fragmented diachronic units. E.g., statements grouped under the diachronic unit "Nerves and emotion" were examined, as shown in Table 4.

After iterative interrogation, two actions were identified: Beating the heart and moving the foot, which correspond to two diachronic units of a higher level of fragmentation or subphases.

Table 4. Iterative questioning of "Nerves and emotion" from EGB.

No.	Statement	Criterion	UDI
27.2 31.1	when it comes to making the decision is an important decision especially at a critical point where the heart begins to beat the most I just feel my heart beating super fast	They talk about the beating of the heart	Heartbeat
71.2 79	I couldn't stop moving any part of my body such as my leg The leg, I always move my leg	The statements talk about moving the leg	Moving the leg

Once a moment was assigned to each statement of the experience described, they were reorganized according to the order of the moments. The process of interrogation described also made it possible to reveal the point of articulation between one diachronic unit and another. The point of articulation, also called the "transitional event" (Petitmengin, Remillieux, & Valenzuela-Moguillansky 2018), is what marks the transition between phases and usually corresponds to both actions and processes, as well as events. In the case of EGB, it is precisely the action of "deconcentrating" that articulates the transition between two phases. As can be seen in Figure 1, another point of articulation between the phases was the action of "breathing", which caused the chess player to move from listening to his own voice to concentrating flatly on the move.

Figure 1. Specific diachronic structure

<table>
<tr><td>Prior to the M.C.</td><td>Phase 1</td><td rowspan="3">Deconcentrate</td><td>Phase 2</td><td rowspan="3">Breath</td><td>Phase 3</td><td>Phase 4</td></tr>
<tr><td rowspan="2">Jugada ya seleccionada</td><td>Nerves and Emotion</td><td>To listen to your voice</td><td>To concentrate</td><td>To relax</td></tr>
<tr><td>Subphase: Beating the heart fast

Subphase: Move the leg unconsciously</td><td></td><td>Subfase: ver en el tablero en 3D</td><td>Subfase: observar un cambio de actitud en su</td></tr>
<tr><td></td><td colspan="5">Decide whether or not to take a risk</td><td></td></tr>
</table>

<table>
<tr><td></td><td>Before moving the part</td><td>After moving the piece</td></tr>
</table>

During the critical moment, that is, during the 3 phases that were obtained before moving the piece, EGB was deciding whether to take the risk of making the move he had already selected or not.

As mentioned before, we found the characteristics of the transition between phases, which are very interesting because they allowed us to see the causes that led us to move from one state or experiential dimension to another different state. This can be observed in the case of JA, who went from being in a situation of fear and stress to a state of relaxation. This point of articulation was the fact of "taking a risk": « [...] stressed and afraid of making a mistake in my calculation and subsequently losing the game, uh, which led me to risk but this … I think I was going to feel dissatisfied that I didn't make that play and could have won».[2]

4.2. Articulation Phases Identified in the Analysis

4.2.1. Phase: Emotional Sensations

This phase comprises positive emotional sensations, e.g., joy, happiness. This is seen in the reactions of EGB and FTR, who were excited to see how the position could be favorable to them. Another reaction that can be experienced is that of feeling at ease with their position, as JA also mentions. It also includes negative emotions presented by different participants, such as nerves, stress, fear of making mistakes and insecurity. It should be noted that this phase is very important at the critical moment because, if this type of emotions -whether positive or negative- are not controlled, they could experience deconcentration, as happened with participant EGB, who was both excit-

[2] By editorial criteria, the testimonies and experiences of the participants in the study will be presented with the characters "« »", to differentiate them from the double quotation marks which will be reserved for quotations and/or to nuance a term or definition. Henceforth, "« »" accompanies the comments, testimonies, and opinions of the participants in the study that the authors present in this article.

ed and nervous at the same time: «I just feel my heart beating super-fast and then I start to lose focus, but I breathe and concentrate on the position. »; «Well I always tell myself like: You have to be careful, don't rush before making the play no matter how good it looks, no matter how excited you are to make it, I mean, or nervous to make it, you always have to, I mean, I have to think if it's going to be or not, then I'm telling myself like calm, calculate, you play well, you can see, you can see deep, then concentrate on seeing the position and not that that move can be very good. »

EGB uses the strategy of talking to oneself and breathing to return to the concentration phase, i.e., it is a point of articulation between the emotional sensation phase and the calculation phase.

4.2.2. PHASE: CALCULATION AND VALUATION

After the emotional sensations phase, in most of the participants comes the calculation part, which is where the players rely on to reduce their insecurity, as in the case of FTR: «my calculation, the calculation I do, in a certain way, takes away that insecurity I feel of knowing what will happen. »

In PG's case, when he was in that phase calculating a move that he had already considered, two possible moves emerged: One based on his calculation and the other that arose suddenly and without any calculation: «Well, one was based on a calculation, and the other, let's say it just came to me, it just came to me. »

The interesting thing is that she just played the move that hit her at the critical moment over the two moves that had arisen because of the calculation she had made. In the case of JA, EGB, and FTR, the calculation was performed after the concentration phase.

4.2.3. PHASE: CONCENTRATION

Concentration can be disturbed by emotions felt by the participants -as observed in EGB in the emotional sensation phase-, no matter if it is positive or negative, since it can affect concentration directly, which is why it is one of the most important points of a critical moment. In the case of FR the concentration phase occurs after the phase of feeling the advantage in the position, where FR feels that there is something in the position and that forces him to stop, take a pause and concentrate.: « [...] I stopped, I stopped for a moment to think, no, even to breathe, not well the position and concentrate, right? Concentrate and then analyze the possible moves. »

In three of the participants (JA, EGB, FTR) the concentration phase was prior to the calculation, i.e., they first entered the concentration phase before performing the calculations. In JA's case, the point of articulation between the concentration phase and the calculation was to replicate the board in his mind in order to perform the calculations and movements.: «First I concentrated and started to make in my mind a chessboard with the same position, but developing the moves in my brain, which over the course of the 15 to 20 minutes I could mmm, see what my player... did in the game and that's what happened. »

4.2.4. Phase: Feeling Of Positional Advantage

This feeling of advantage in the position is, as FR mentions, «like feeling that there is something and palpating a certain advantage. » It is worth mentioning that FR is the highest rated player in the group of participants in this study. FR even mentions the word intuition and attributes it to the experience that develops over the years.: « [...] I felt... that intuition that a chess player develops over the years of feeling that there is something, that there is something, so I felt that at that critical moment there was a way to take advantage, but no longer a way to take advantage, let's say, in the long term, but something palpable in the short term. »

In JA's case the feeling of winning occurs just after his opponent makes his move, i.e. at the beginning of the critical moment, and reaches a position that JA had already calculated in advance: «I felt a little bit let's say with that feeling of, ahh, I already have a chance to win, to win a little bit easier. »

4.2.5. Phase: Sense of Relief and Satisfaction

All participants reached this stage after making their move, regardless of the consequences of the move: "whatever happens, happens" (FTR). Players experience stress relief or a satisfaction of having completed the previous phases, but to get to this last phase all participants first went through a point of articulation; an example was the case of JA mentioned above, who decided to take a risk to reach a state of relaxation. In the case of FTR, he reached this stage feeling all his insecurity being transferred to his opponent when he made his move: «And it's like strength, to give the play and that insecurity I passed it on to the opponent just as he has to be in my shoes as I was in now what to do. »

Another interesting finding was that among the group of players, only FR used imagination as a cognitive strategy when visualizing the board in two dimensions in his mind to make move calculations. It should be noted that it is also the one with the highest ability, as it is the only one that exceeds 2000 rating points: « As in two dimensions exactly, I can't imagine analyzing in 3, I think it would be much more difficult. Maybe there are people who do it, but at least I do it in two, so of course, when you do it in two there are things that can escape you, because maybe you missed a piece that was on a8, maybe you didn't see it well, then suddenly you see it and you say ah, but it was there, then it happens many times that you analyze the position but in a certain region of the board, For example, the attack is on the kingside and as if he imagines a 5x5 square in that region, but he forgets that there is a whole area besides that region and maybe he forgets that there is a bishop over there that can protect in a distant way, but in the end it is there, so that is the difference. »

This may lead one to believe that the player performed better when imaging in 2D. In addition, this player is the only one who did not show stress in his game, i.e., he has better emotional control than the others. Another interesting aspect was that some of the participants used metaphors to understand their experience during the game, for example JA, who felt that the game is like a coin in the air and that the coin is spinning and the game is defined when the coin drops: « [...] I felt like when I toss a coin in the air, and it is 50-50, where I believe that luck also plays an important role, and when I imagined that a coin fell and one chooses which side, I felt that that side was for me, so I put all my concentration in the game to win, and in the end that is what happened. »

5. Discussion

After analyzing the interviews, very similar patterns were detected regarding the critical moments of the participants, where emotions play a very important role. This tells us that proficient players do not rely on their sense of advantage simply on their intuition, but confirm it with calculations, i.e., with their knowledge of chess (Dreyfus & Dreyfus 1986). The stress they present is due to the feeling of insecurity they still have, which occurs despite having selected their move before reaching the critical moment. Players want to be sure that the selected move is the correct one. It should be noted that four of the participants had already selected the move they would make at the critical moment, but during the calculation and analysis stage they wanted to make sure that the move they had thought of was the correct one. It was there that the stage of stress, fear and uncertainty arose, as most of the time they were thinking about whether to take a risk. The only exception was PG; as noted in his structural analysis, his move emerged suddenly in the calculation phase and was ultimately the move he executed at the critical moment.

Considering the results obtained, it is possible to affirm that the players make mental simulations each time the position changes on the board, and process them for each future position, perhaps not all of them consciously, but when the critical

moment arrives, the player has already selected the move he will make, which he apparently anticipated several moves ago.

For the predictive model to perform correctly, there are other factors that influence the construction of this "intuition", such as the control of emotions, concentration, experience, cognitive strategies, among others. This simulation model construction improves with experience, in addition to all other factors. This would explain why very few players reach a high level of expertise. The improvement in their predictions depends heavily on the acquisition of new patterns or chunks (Chase & Simon 1973) that are acquired through experience. Another important point that was found is the dependency that proficient players still have in their rational calculations of the possible plays. They base their confidence more on their reflections than on their intuition, which also results in higher energy expenditure. This may be different in expert players, who, by using less rational calculations, involve less body wear and tear, and this causes their efficiency to be better during the game, thus maintaining greater stability in their ability to concentrate.

It is important to note that proficient participants use strategies that allow them to maintain a state of high concentration, as it is very difficult to maintain stable concentration processes during critical moments. When emotions arise in these situations, proficient players use strategies that allow them to return to their state of concentration without letting these emotions have a negative influence.

One way to explain the cognitive strategies used by the players who participated in this study - specifically in visualizing the board, whether in 3D or 2D - is that mental imagery can function as an internal spatial medium that, in turn, serves as a workspace for solving a problem (Pinker & Kosslyn 1978). The extraordinary flexibility of the human mind allows spatial mental operations to be applied to both imaginative and perceptual stimuli, providing the means not only to anticipate states and processes in the world but also to create new states and processes in the imagination (National Research Council 2006).

According to Pittalis and Constantinos (2010), there are several types of 3D reasoning that are related to people's spatial abilities. These authors comment that spatial structures are easier to understand in 2D than in 3D. In fact, it is more dif-

ficult to handle spatial relationships in 3D than in 2D (National Research Council 2006). This suggests that the more assertive player will use 2D visualization, as it is a more efficient and economical strategy for the brain. The results of the present study show some similarity with the model proposed by Dreyfus (1986) since in proficient level players many of their actions depend on their rationality. However, the model neglects several factors such as emotions, which are an invariant structure that appears in most of the results. Dreyfus does not include emotions in his model even though they play a very important role when a proficient player executes an action, since, as could be seen in the analysis, they are related to the level of concentration.

6. Conclusions

After analyzing the micro-phenomenological interviews, we obtained the phases that make up a critical moment of a game in proficient players. When most of the players reached the critical moment, they had previously made various move calculations: This indicates that players always try to rationally anticipate the possible variations of each move. However, it is difficult to define at what point they make these calculations, as they are constantly simulating the possible responses of their opponents from the start of the game. In any case, a time frame of the experience (the critical moment) was set to know what processes were carried out.

On the other hand, understanding whether intuition plays an important role in proficient players is undoubtedly a question that cannot be isolated from other factors that are part of the action process such as emotions, calculation, positional assessment, concentration, and the cognitive strategies that each player uses to carry out the process. This tells us that, for a chess player to reach a more efficient level of play, he must be able to have both a balance between his emotions, concentration and calculation, and better prediction models. From the previous reviews it is evident that this balance sheet is built up as more experience is gained.

From the above, we can understand intuition as the implicit modulation of cognitively relevant internal factors (operating in parallel) for the optimal control

of an action or outcome. In the context of proficient chess players, it does indeed seem to play an important role; however, calculation prevails mostly as the ultimate basis for their actions at the board. It is possible that the action is already decided pre-reflexively as this "intuition" develops in parallel. The latter would be triggered at a critical moment and makes us think that it appeared "all at once", when in fact it would be the result of an accumulation of changes in the trees of possibilities, which, depending on the path they follow, will cause a certain idea to emerge. Calculation would still be the basis of the actions of proficient chess players because they do not yet have sufficient knowledge of the different positions presented to them: the chunks (Chase & Simon 1973) they have acquired through their experience are not yet sufficient (nor, perhaps, their processing sufficiently "fluent") to reach a high level of expertise -unlike the grandmasters of chess. And, correlatively, the modulation and control of the different internal factors that intuition makes possible are not yet operationally enabled for the group of proficient players.

There are other variables that can be considered for future research on expertise in chess players, such as those proposed by Hambrick, Campitelli, and Macnamara (2018). In them, multifactorial expertise models include variables such as the age at which a player starts playing chess, socioeconomic status, parental support, personality, temperament, motivation, among others. The topic investigated in this work is undoubtedly of growing interest, as indicated by recent studies on car racing drivers, which have found similarities with the performance of chess players specifically in terms of pattern recognition (Lappi & Dove 2022).

Finally, it is recommended for future research to use the micro-phenomenological interview again, but this time with expert players, that is, with chess grandmasters, and compare the results with those of the present research. Unfortunately, it is very difficult to do so in Mexico due to the scarcity of high-level players, an aspect that represented one of the limitations of this study.

Bibliography

Aciego, Ramón., García, Lorena y Moisés Betancort. "The Benefits of Chess for the Intellectual and Social-emotional Enrichment in Schoolchildren". *The Spanish journal of psychology* 15.2 (2012): 551-559. <https://doi.org/10.5209/rev_SJOP.2012.v15.n2.38866>

Austin, John Langshaw y Urmson J. O. *Cómo hacer cosas con palabras*. Barcelona: Paidós, 1990.

Astudillo Sandoval, Isidoro. *Expertise del ajedrecista desde una perspectiva fenomenológica.* Tesis de Maestría en Ciencias Cognitivas: Universidad Autónoma del Estado de Morelos octubre, 2020. 1-57. < http://riaa.uaem.mx/handle/20.500.12055/1308>

Baddeley, Alan David. "Working Memory". *Philosophical Transactions of the Royal Society of London.* B, Biological Sciences 302.1110 (1983): 311-324. <https://doi.org/10.1098/rstb.1983.0057>

Bratko, Ivan. "AlphaZero–what's missing?" *Informatica* 42.1 (2018): 7-11. <https://www.informatica.si/index.php/informatica/article/view/2226>

Bueno, Lázaro. *Ajedrez juego ciencia y con ciencia.* La Habana: Sello Editorial Academia, 2015.

Burgoyne, Alexander P., et ál. "The Relationship Between Cognitive Ability and Chess Skill: A Comprehensive Meta-Analysis". *Intelligence* 59 (2016): 72-83. <https://doi.org/10.1016/j.intell.2016.08.002>

Connors, Michael H., Burns, Bruce D. y Campitelli, Guillermo. "Expertise in complex Decision Making: the Role of Search in Chess 70 years After de Groot". *Cognitive science* 35.8 (2011): 1567-1579. < https://doi.org/10.1111/j.1551-6709.2011.01196.x>

Charness, Niel. "Search in Chess: Age and Skill Differences". Journal of Experimental Psychology: *Human Perception and Performance* 7.2 (1981): 467-476. <https://doi.org/10.1037/0096-1523.7.2.467>

Chase, William G., y Herbert A. Simon. "Perception in Chess". *Cognitive Psychology* 4.1 (1973): 55-81. <https://doi.org/10.1016/0010-0285(73)90004-2>

De Groot, Adriaan D. *Thought and choice in chess.* Berlin, Boston: De Gruyter Mouton, 2014. <https://doi.org/10.1515/9783110800647>

Dorfman, Iossif. *El método en ajedrez.* Editorial Chessy, 2004.

Dreyfus, Hubert., Dreyfus, Stuart E. y Athanasiou, Tom. *Mind over machine: The Power of Human Intuition and Expertise in the Era of the Computer.* Simon and Schuster, 1986.

Feltovich, Paul J., Prietula, Michael J. y Ericsson, K. Anders. "Studies of Expertise from Psychological Perspectives". *The Cambridge Handbook of Expertise and Expert Performance*. Cambridge: Cambridge University Press, 2006. 41-68. <https://www.doi.org/10.1017/CBO9780511816796.004>

Gobet, Fernand. *The Psychology of Chess.* London: Routledge, 2018. <https://doi.org/10.4324/9781315441887>

Gaprindashvili, Paata. *Critical Moments in Chess.* London: Batsford, 2013.

Hambrick, David Z., Campitelli, Guillermo y Macnamara, Brooke N. *The Science of Expertise.* New York, NY: Routledge, 2018.

Holding, Dennis H. "17 Search Process Versus Pattern Structure in Chess Skill". *Advances in psychology.* Vol. 93. North-Holland, 1992. 649-676. <https://doi.org/10.1016/S0166-4115(08)61029-8>

Kasparov, Garry. Deep *Thinking: Where Machine Intelligence Ends and Human Creativity Begins*. Londres: Hachette UK, 2017.

Lappi Otto y Dove Alan. *The Science of the Racer´s Brain.* Editorial: Otto Lappi, 2022.

Montero, Barbara., y Evans, C. D. A. "Intuitions without Concepts Lose the Game: Mindedness in the Art of Chess". *Phenomenology and the Cognitive Sciences* 10.2 (2011): 175-194. <https://www.doi.org/10.1007/s11097-010-9192-9>

National Research Council (US). Committee on Support for Thinking Spatially, et ál. *Learning to think spatially: GIS as a support system in the K-12 curriculum.* National Academy Press, 2006. <https://doi.org/10.17226%2F11019>

Petitmengin, Claire. "Describing one's Subjective Experience in the Second Person: An Interview Method for the Science of Consciousness". *Phenomenology and the Cognitive sciences* 5.3 (2006): 229-269. <https://doi.org/10.1007/s11097-006-9022-2>

Petitmengin, Claire., Remillieux, Anne., y Valenzuela-Moguillansky, Camila. "Discovering the Structures of Lived Experience". *Phenomenology and the Cognitive Sciences* 18.4 (2018): 691-730. <https://doi.org/10.1007/s11097-018-9597-4>

Pinker, Steven., y Kosslyn, Stephen M. "The Representation and Manipulation of Three-dimensional Space in Mental Images". *Journal of Mental Imagery* 2.1 (1978): 69-84.

Pittalis, Marios., y Christou, Constantinos. "Types of Reasoning in 3D Geometry Thinking and Their Relation with Spatial Ability". E*ducational Studies in mathematics* 75.2 (2010): 191-212. <https://doi.org/10.1007/s10649-010-9251-8>

Robbins, T. W., et ál. "Working Memory in Chess". *Memory & Cognition* 24.1 (1996): 83-93. <https://doi.org/10.3758/BF03197274>

Sadler, Matthew., y Regan, Natasha. Game Changer: *AlphaZero's Groundbreaking Chess Strategies and the Promise of AI.* Alkmaar. The Netherlands: New in Chess, 2019.

Schear, K, Joseph. "*Mind, Reason, and Being-in-the-World The McDowell-Dreyfus Debate*". London: Routledge, 2013. <https://doi.org/10.4324/9780203076316>

Trinchero, Roberto. "Can Chess Training Improve Pisa Scores in Mathematics? An Experiment in Italian Primary Schools". *Kasparov Chess Foundation Europe* (2013): 1-18

Vermersch, Pierre. "La entrevista de explicitación".*Independently published*, 2019.

Zeynalli, Aytan. *Educational Impacts of Chess Instruction in Azerbaijan.* Diss. ADA University, 2015. <http://dx.doi.org/10.13140/RG.2.1.1002.3128>

Chess Terms Glossary

Blindfold chess: A game played without seeing the board.

Opening: The first phase of the game where both sides try to develop their pieces and put their king in a safe place.

Calculate: Analyzing several moves in advance.

Development: The process of moving pieces from their starting squares to give them greater mobility or influence in the game.

Elo: A system for measuring player strength, invented by Arpad Elo, which has been used officially since 1970.

FIDE: International Chess Federation.

Endgame: The final phase of the game, when there are few pieces left on the board.

Flank: The sides of the board. The a-c flank is the queen's flank, and the f-h flank is the king's flank.

Fortress: A position where the side with less material is able to achieve a draw by not allowing the stronger side to penetrate the position.

GM: Abbreviation for Grandmaster, the most prestigious official title. To achieve this, one must reach an Elo rating of 2500 and make three performances (called norms) of 2600.

Checkmate: When the king is in check and cannot avoid being captured on the next move.

Candidate moves: The possible moves that, at first glance, seem to be possible in a position.

Norm: Performances in tournaments necessary for titles. For IM (International Master) they must be 3 performances of 2450 and for GM, 3 of 2600.

Chessboard: The 64-square board is an 8x8 square where white and black squares alternate.