



Online ChessQuiz by Laszlo Moldovan (Schaakacademie Apeldoorn)
 IM Mark Dvoretzky and GM Artur Yusupov, Apeldoorn 2010 (photo team captain Karel van Delft)



Candidate moves: When you see a good move, look for a better one

Chessable science team research paper

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Abstract

What are candidate moves? What is their role when selecting the right move and continuation in a chess position? Is the method trainable and if so, how?

These questions were investigated by interviewing grandmasters, reviewing chess literature, and cataloguing psychological insights. For an online study with 207 chess players, candidate moves were defined as the moves that deserve attention in 10 provided chess positions. Participants experienced one of two conditions: prompted to consider candidate moves or just asked to find the best move. The hypothesis was that chess players make better decisions when prompted to consider candidate moves. However, there were no significant differences in performance. Possible reasons are discussed.

One conclusion is that choosing candidate moves is multifaceted, about a concept as well as methods, and trainable. Pattern recognition plays a crucial role in recognizing possibilities and limitations when evaluating positions. Further research could be about different chess positions and technical methods in relation to specific groups.

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Hypothesis

Chess players make better decisions if prompted to consider candidate moves compared with players who are just asked to find the best move.

Definition Candidate Moves

Candidate moves are the moves that deserve attention in a given chess position.

INTRODUCTION

What are candidate moves? What is their role when you must select the right move and continuation in a chess position? Is the method trainable and if so, how?

When you see a good move, look for a better one. So look for candidate moves.

The advice has often been attributed to world champion Emanuel Lasker, but also to Pedro Damiano.

This paper reports about in-house research of a workgroup of the Chessable science team. Members of this workgroup are Chessable science project manager Karel van Delft (coordinator), IM/GM of chess composition Yochanan Afek, Dr. Benjamin Balas, GM Sipke Ernst, GM Johan Hellsten, Dr. CM Can Kabadayi, Laszlo Moldovan, Dr. WIM Alexey Root, and Dries Wedda. Consultants are GM Artur Yusupov and IM Merijn van Delft. During the research we consulted many titled chess players and scientists.

This paper starts with an interview with GM Artur Yusupov, who wrote about the topic in several books.

GM Artur Yusupov: You have two ears because you have to hear both sides.

We describe what several chess authors wrote in books and articles about candidate moves.

GM Alexander Kotov: Examine each branch of the tree once and only once

GM Michal Krasenkow: Start with the simplest variation

IM Mark Dvoretsky: The Technique of Analysis and Decision-Taking

GM John Nunn: The Tree of Analysis revisited

GM Rafael Leitao: No grandmaster calculates the way Kotov prescribes

GM Johan Hellsten: As a human player, one has to be practical

GM Valeri Beim: When there is a choice of plans there is a choice of candidate moves

GM Jacob Aagaard: Before you can think, you need to learn how to see

GM Sam Shankland: Don't follow immediately your intuition

GM Lev Alburt: How to think about a position

IM John Bartholomew: Without candidate moves you will suffer a lot of defeats

FM Amatzia Avni: The Grandmaster's Mind

GM Andrew Soltis: Being able to recognize candidate moves is an essential, time-saving skill

GM Andrew Soltis: The wisest things ever said about chess

IM Willy Hendriks Move First Think Later: There is no order in the way we look at the board

IM Merijn van Delft review book 'Move First, Think Later': Speculation is a good start

GM Michael Adams and Philippe Hurtado: Think Like a Super GM

GM Josh Friedel: They are not considering enough options

GM Stefan Kindermann: Backwards thinking is a powerful tool

This list is not exhaustive. However, as we discussed with GM Artur Yusupov it seems to cover the essence of discussions about candidate moves well.

A good read is also: Ramesh RB, Improve Your Chess Calculation, New In Chess, 2022. He refers in his book to several authors we discuss. Also Dr. Fernand Gobet says interesting things in lectures and books. Dr. Barry Hymer and GM Peter Wells give insight in the mindset and thinking processes of grandmasters.

Scientific research is about description, explanation, predicting, and influencing phenomena.

In this research paper we also reflect in chapters on what psychology and science can contribute.

About especially the application of candidate moves we did not find scientific research.

Although, a lot of research is done about relevant cognitive issues as pattern recognition, perception, heuristics, reasoning, problem solving, decision making, searching strategies, calculation, cognitive biases, memory, intuition and metacognition.

There is also research about skill development, expertise development and deliberate practice.

Mental aspects are of influence such as self-knowledge, self-management, mind-set, task oriented attitude, mental skills and competences, productive thinking routines, self-talk, stress regulation, resilience, motivation, and concentration. These aspects can be related to social aspects like learning by observing, role models, and social interaction.

Physical aspects play a role in how well chess players perform. And sometimes coincidence and luck play a role.

For this research a hypothesis was formulated:

Chess players make better decisions if prompted to consider candidate moves compared with players who are just asked to find the best move. Candidate moves are defined as the moves that deserve attention in a given chess position.

To test the hypothesis, the researchers used the online 'ChessQuiz', developed by Laszlo Moldovan. Participants in the research were asked to solve ten tactical positions (and two in advance to become familiar with the quiz).

There were two conditions. Both test groups were asked to solve online the same ten positions, with a maximum of five minutes for each puzzle. In the experimental condition the participants were asked to use the method of candidate moves. In the control condition participants were just asked to choose the best move. At the end of the test participants were optionally asked to answer some open questions.

The research design and results are later described in detail in this paper.

The paper pays attention also to problems and studies, which are very rich in candidate moves and make good training material.

The computer era is reflected in developments in the way chess players think. This is discussed in an interview with two young Dutch grandmasters, Liam Vrolijk and Thomas Beerdsen.

The paper ends with a summary of the research conclusions. In a discussion the researchers reflect on the research and make suggestions for further research.

The research is summarized in a Chessable blogpost. The research serves as a source of inspiration for a Chessable course about Candidate Moves.

Questions and comments about the research are welcome. Contact the authors via

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EXPERT INTERVIEW WITH GM ARTUR YUSUPOV

- By Karel van Delft

GM Artur Yusupov: You have two ears because you have to hear both sides

The theme of candidate moves is extremely important for chess players, GM Artur Yusupov says.

'I am working with a lot of young people and children. For them it is a concept that is not obvious at all. Because they look at the position, see a move and think that's it. The concept that there could be two candidate moves is already revolutionary for many of them. If you ask them maybe you have some alternative idea they already are astounded. What about an alternative move? What can it be?' Thinking about candidate moves is an important stage in the development to be able to see there is not only one solution. But not only young people, also adults think they immediately see 'the' solution, before they start really thinking, Yusupov says.

In his German books 'Tigersprung' and 'Schachunterricht' Yusupov describes candidate moves as a method of thinking, not only as a concept. The 'Tigersprung' books are in English translated as 'Boost your chess', 'Build up your chess' and 'Chess Evolution'.

Yusupov refers to articles of GM Michal Krasenkow and IM Mark Dvoretsky in the book 'Attack & Defence' which he wrote with IM Mark Dvoretsky.

According to Krasenkow the big point of the candidate moves concept is that at some moment in a variation you calculate maybe you see some idea. This idea could totally change your view about how you look at the position. And maybe you come back, knowing this idea, to the initial position and look at it again and try to find the candidate moves which are connected with this new idea. This coming back is extremely important in the process of finding the solution. This procedure brings us to new candidate moves. The idea of coming back to the initial position and looking again belongs to Mark Dvoretsky, Yusupov says.

Yusupov says his vision is a little bit different from Krasenkow. Krasenkow says after you get a new idea you have to come back to the initial position and check your candidate moves.

Yusupov thinks that looking at the position you have maybe a candidate move and you don't see the solution. That may only mean your candidate moves are not complete. He advises to go to the initial position and look for more candidate moves.

Yusupov says ideas of systematic working on candidate moves as proposed by GM Alexander Kotov might work at correspondence games or analysis where the factor of time is not important.

Yusupov mentions the Kahneman book 'Thinking fast and slow'. There are certain concepts which are very close to analysis in chess. Kahneman has some parallels to chess, but they are not good. 'But okay he is not a chess player, but it doesn't matter, we can use his thoughts for chess training.' Quick thinking has to do with quick decisions, without candidate moves. Slow thinking is about different possibilities, it is a more difficult process, which people don't usually like to do, because it takes effort.

The concept of candidate moves involves aspects of searching strategies and decision making.

Research about candidate moves is useful, Yusupov states. 'It could lead to methodological advice for training.'

'At what rating level people apply candidate moves is probably different. It also depends on what training they have and depends on their coach.'

The concept of having different possibilities is difficult for children because it requires a certain level of understanding. Pattern recognition is important here, a trainer should show many positions which can be recognized. But it is more, also has to do with knowing and see quickly what pieces can do. This you can train via tactics training methods, such as the Dutch Steps Method and some Russian courses.

'Maybe pattern recognition exists at different levels. It has to do with recognizing positions and ideas and operations connected with it. Botvinnik used to say he recognized possibilities from positions from older games. Nobody saw them, but Botvinnik saw similarities.' E.g. Botvinnik referred to a game of his against Rabinovich. Yusupov didn't see a connection, but Botvinnik saw. 'But it is maybe

not only pattern recognition, but synthetic qualities, bringing in ideas in different circumstances. This ability to recognize things was perhaps his greatest strength.'

How do you train your students to think via the method of candidate moves?

'The first stage is: see possibilities on the board. The second stage: realize you have an opponent. That makes thinking more complicated.'

Yusupov's method during trainings is not very sophisticated, Yusupov says. 'I am just asking, what are the alternatives, what are the other things in the position? We also train to look for active possibilities.' This is important for the first stage, but also for the candidate moves. But not all active moves are good. You take from active moves the moves that make sense to you, that are your candidate moves. As preparation a trainer can ask: how many checks do you see, and which make sense to you?

Very seldom a candidate move is not an active move.



14. Qd4

Higher-level players face another problem with searching for candidate moves: you don't recognize the merit of a move immediately. Yusupov mentions his own game against Nogueiras, where after long thinking he went back to initial position and found a move with five threads.

See <https://www.chessgames.com/perl/chessgame?gid=1241882>

'As a coach I see some people, even at a good level, use limited candidate moves, and young people have a tendency to make a quick judgement.' In a training in Vienna (thinking about Kahneman) Yusupov asked a young player with a quick judgement: if you would be a judge in a court, would you also immediately have a verdict and condemn people? 'Many people think for five seconds and know the answer. One poet said: you have two ears because you have to hear both sides. That is what candidate moves are about.'

In several books Artur Yusupov writes about candidate moves. Here we summarize the most important remarks. All the books contain explanations with game examples and exercises.

Schachunterricht Chapter 2 Kandidaten Züge

Candidate moves are the basis of each variation in calculation.

Before we calculate variations we choose interesting possibilities, which means candidate moves. Sometimes we are satisfied with just one continuation, more often we can choose between two or three directions and sometimes more. Humans cannot calculate everything like computers. By decreasing the number of moves we can concentrate on just a few main directions. That is the strength of humans, but at the same time our main weakness: when the selection is too small, we can fail to see the strongest continuation.

The evaluation of the position is a compass for chess players. Searching for candidate moves is a creative process, there is no simple algorithm. But there are some priorities when selecting candidate moves.

- 1- Consider all active possibilities: giving check, take and attack. With these moves you have to start calculating variations.
- 2- Look at a position through the eyes of your opponent and take into account their possibilities.
- 3- Don't start directly analysing. When you elect a few candidate moves, first make an interim

assessment of the position. Might there be no clear and attractive continuation, then go back to the initial position and look for other candidate moves.

4- Ask yourself from time to time if there are no other possibilities. Sometimes it happens that ideas which you found during calculation of variations lead to a very new vision on the initial position.

Tigersprung DWZ 1800 Band 1 (chapter 7)

Here Yusupov gives some guidelines:

1. Calculating exactly the first moves is more important than the skill to calculate long variations.
2. Look for your own candidate moves, but also for the opponent.
3. First look at active possibilities (check, take, attack).
4. If your candidate move doesn't work, look for other candidate moves.

Tigersprung DWZ 2100 Band 2 (chapter 9)

The chapter is about the technique of calculating variations.

Yusupov says in chess there are no absolute rules or algorithms for calculating variations. 'The situation on the board can differ and there are different methods to come to a decision. Mental flexibility is important. The most important methods are candidate moves, comparison method, and elimination method.

Candidate moves are the kernel of calculating variations. If your chosen candidate moves don't work, try to find other ones.

When you attack: first try the most active moves.

When you defend: use the elimination method (which moves don't work) and comparison method.

Concentrate on the first moves.

Each variation should end with an evaluation. This evaluation should end where the opponent runs out of active possibilities.

Tigersprung DWZ 2100 Band 2 (chapter 15)

In this chapter Yusupov repeats guidelines, but he gives new game examples and exercises.

References:

Artur Yusupov, Schachunterricht and book series Tigersprung, Jussupow Schachacademie Verlag
www.jussupow.de

WHAT CHESS AUTHORS SAY

GM Alexander Kotov: Examine each branch of the tree once and only once **- Review Karel van Delft**

Russian Grandmaster Alexander Kotov put candidate moves on the chess thinking agenda with his book 'Think like a grandmaster'. The first chapter is called 'Analysis of Variations' in which he discusses the 'Tree of Analysis' and the 'Selection of Candidate Moves'.

In his preface Kotov says an immense number of books have been written about chess, but 'strange as it may seem, no one has had the idea of describing the methods by which the leading players of our time have reached the peak of their playing strength. Yet a study of these methods would greatly facilitate the process of mastering the intricacies of the game.' The main factor to reach success is putting great effort into mastering the skills of chess strategy and tactics, Kotov says.

Chess thinking is complex, and it starts by trying to recognize and assess positions. If so, one can know which ideas and plans are connected to the positions. There are differences between grandmasters: some rely more on sober analysis while others use more intuition. Making plans is based on features of positions, but also the character of players is of influence. Along with their general plan a grandmaster will have a more concrete plan for the next moves. For the best move they will establish what moves are possible and how those moves fit in their plan. Then it is time to analyse variations.

A chess player needs five qualities: 1. Know opening theory, 2. Know principles behind positions, 3. Assess positions accurately and correctly, 4. Choose the right plan which meets the demands of a position, 5. Calculate accurately all significant variations.

Chapter 1 'Analysis of Variations' starts with the question what to do if you have a choice between two moves. Many players doubt, again and again check both moves and after spending a lot of time without much ado go for a third move, often a bad one. Kotov states it is necessary to think about possible moves with the greatest efficiency.

Mistakes in our chess thinking we can overcome by self-critical analyses of our games. Kotov's own experience was that he had a lot of knowledge but failed in analysing variations correctly. Time trouble and blunders resulted. Discussing a game against Panov he said: 'To what a laughable extent my thinking is based on general principles and plans.' Examining games of other players and reading comments, Kotov concluded that being able to analyse clearly a sufficient number of variations is the basic condition for success. Besides it is necessary to analyse enough but not too many variations and find a balance between too short and too deep variations.

There are several methods to analyse such as analysing without a board and comparing your own annotations with those of book authors. In particular, the 'tree of analysis' and choosing which moves to analyse are helpful.

Three factors guarantee finding the right move, Kotov says: Accurate analysis of all variations that can be logically considered, confidence that you have taken account of all the best moves, and strict economy in thinking time.

About The Tree of Analysis: A grandmaster will not check variations for a second time because it is a waste of time, Kotov says. One must teach oneself to analyse accurately and have confidence in that analysis.

Kotov formulated as a rule: *When analysing complicated variations, examine each branch of the tree once and once only.*

This starts with analysing all possibilities on the basis of which we choose candidate moves. About candidate moves Kotov formulates as a rule: *Candidate moves must be established straight away and they must be clearly enumerated.*

About Selection of Candidate Moves: Grandmasters think differently, the search for the best move is a creative process and demands more than knowledge of strategy and tactics, more than experience and knowledge of standard methods. It is in this process that a player shows their best qualities: breadth of thought, boldness, and creative ability. Imagination is necessary.

What is a Candidate Move? How to decide which moves are candidates and how many of them there are in each position? This is hard work and requests disciplined thinking. There is no standard answer to the question how many candidate moves a grandmaster examines. In each position they examine as many as seem necessary in the given circumstances. Missing a candidate move might cost the game.

Kotov refers to Blumenfeld who wrote that in long variations the imagined position becomes fainter. This has influence on the correctness of the assessment of a position. Blumenfeld advises after your opponent has moved you should start from scratch and not on your previous conclusions. Kotov advises to 'train your fantasy' by methods such as solving puzzles and studies and especially looking for unusual moves.

About gross blunders Kotov says the reason can be found in the psychology of the grandmaster's mind. 'Once we have found the real reason we can find ways to combat the occurrence of blunders in our own play.' Often lowering of vigilance when your position is very good is the main reason, Kotov states. He calls it 'Dizziness due to success.'

Kotov says 'conditioned reflexes' explain well many actions of players. Many years of habit-forming experiences guide their (subconscious) thinking. Although most of the time helpful, in certain circumstances automatic response patterns can be harmful. Kotov mentions also blind spots as a result of perception processes.

Kotov discussed blundering on the very first move with Soviet chess master and psychologist Blumenfeld. He calls the result the Blumenfeld Rule: after long analysis look at a position through the eyes of a patzer, is there a mate or a capture possible?

There are positions and even whole games, Kotov states, where analysis recedes into the background and the principal factor is positional judgment, overall assessment. In those cases a grandmaster

relies on their positional understanding, which is developed by experience.
Might you are annoyed of the behaviour of your opponent, Kotov took over an advice by Smyslov:
Take a little stroll.

References:

Alexander Kotov, *Think Like a Grandmaster*, Batsford Ltd London, First algebraic edition 1995.
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GM Michal Krasenkow: Start with the simplest variation - Review Karel van Delft

GM Michal Krasenkow wrote as a guest author an article about candidate moves in the book 'Attack and Defence' by IM Mark Dvoretsky and GM Artur Yusupov (1998). The title of Krasenkow's chapter is 'Wandering in the jungle'.

Calculation of variations is one of the fundamental elements determining a chess player's choice of move, he stated. Important are organizing and disciplining your thoughts.

In his book 'Think like a grandmaster' GM Alexander Kotov came up with the fundamental concept of the 'tree of variations'. He advised to go down each branch only once.

This vision was later criticized and seen as too rigid.

Krasenkow observed that essentially the tree of variations is formed during the process of calculation. In the chapter he tried to present a more complex algorithm for calculation.

He mentioned points of attention, such as:

Define the aim of your analysis (material plus, positional advantage etc.)

Look for ideas to achieve the aim

Analyse the variations in order of priority

If you find a continuation which achieves the aim stop with short time, continue if more time

Krasenkow mentions an important point: Often a new idea (new candidate) will not be found in the initial position but at the end of a series of moves, which can lead to a new candidate variation.

Krasenkow ended: I am far from imagining that my proposed algorithm is applicable to all complex positions like any other algorithms however - in fact like any method of organizing one's thinking - it can yield good results once it is absorbed into a player's subconscious and he follows it automatically. However this can only be achieved by special training, a matter to which too few players, alas, give sufficient attention.

In the foreword of his book 'Finding Chess Jewels' (publisher Everyman chess) Krasenkow says imagination and calculation are two of the most important qualities of a chess player. He agrees with IM Mark Dvoretsky 'a human is not a machine, hence there is no ideal algorithm of calculation'.

The book is also a Chessable course: <https://www.chessable.com/finding-chess-jewels/course/87883>

In the book Krasenkow gives several pieces of advice:

Before you start calculating, set up a target.

Don't move too fast in variations, it is more important to miss no candidate moves.

Two criteria are important regarding the order of variations to examine: effectiveness and simplicity.

In some situations, use advice by Mark Dvoretsky: Exclusion (choose a move which is not worse than others), Comparison (don't calculate worse moves) and The emergency exit (play safe if necessary).

Very useful is the Blumenfeld rule: check your move again via the eyes of a beginner.

With the years come new insights. During the Kortschnoi Memorial in Günzburg in 2023

(www.legends-of-chess.com) organized by GM Artur Yusupov, Karel van Delft had a conversation with GM Michal Krasenkow. During dinner Krasenkow said he is critical about his article in Attack & Defence. He says now about finding candidate moves the most important principles are:

1. Start with the simplest variation, which often are forced moves.
2. Then start with moves that seem strong, based on pattern recognition, intuition and experience.

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Michal Krasenkow chapter 'Wandering in the jungle' in 'Attack and Defence' by Mark Dvoretsky and Artur Yusupov, Batsford London, 1998.

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IM Mark Dvoretsky: The Technique of Analysis and Decision-Taking

- Review Karel van Delft

In the first chapter of the book 'Attack & Defence' IM Mark Dvoretsky discusses the technique of analysis and decision-taking. The book is written by Dvoretsky himself and GM Artur Yusupov. What do we think about during a game of chess? We look for promising possibilities, compare them with each other, work out variations, try to neutralize our opponents counterplay, and so forth. All this is a creative process which admits of no recipes suited to all cases, Dvoretsky states. Although there do exist rules and precepts of thought, which can help us to organize and regulate our thinking process.

Dvoretsky examined two thought-processes in this chapter:

1. Methods of searching for a move and calculating variations.
2. Means of economizing time and effort; rational thinking.

Technique of searching for moves and calculating variations

Dvoretsky gave several pieces of advice which he illustrated with examples from games:

1. Candidate moves

Identify all the possible candidate moves, not just for your first move but for subsequent ones – and not just for yourself but for your opponent.

Discussing several games Dvoretsky gave advice such as:

It is not essential to work out all variations accurately.

First examine the most forcing line.

The precise order of moves is important.

Select in a critical situation the number of possible continuations. Calculate them all.

The exploratory function of finding candidate moves is important. It enables us to avoid a typical mistake that nearly all chess players make time and again – plunging straight into analyzing the first continuations that come into their head.

If we have concentrated on seeking out all the sensible candidate moves, we sometimes discover resources whose existence we never suspected at the outset.

It is not only important to draw up a complete list of candidate moves; you must also decide on the best order in which to examine them.

No technique is of any help if a player lacks keen combinative vision. This quality must be developed and trained by regularly solving appropriate exercises.

2. What could I have missed?

From time to time take a look at the position with fresh eyes.

Don't be in a hurry to calculate too far ahead. First ask yourself how essential it is. New ideas at the start of a variation are a good deal more important than refinements at the end of it.

3. Should we recheck our calculations?

Kotov's principle to go down each branch of the 'tree of variations' only once seems dubious.

We are not exploring possibilities; we are looking for the strongest moves. They don't always come into our head immediately.

Sometimes an intermediate move must be inserted, which looks pointless at first sight.

4. Keep a mental note of the results of your calculations; end each variation with a conclusion

A precise evaluation is not always essential. E.g. you can postpone if assessment is difficult.

5. Prophylactic thinking

It often helps to begin thinking about the position by asking 'What does my opponent want? Which resources does the opponent have?'

6. What is the drawback to my opponent's move?

If they make an unexpected and disconcerting move, ask yourself this question.

7. What am I trying to achieve?

Clarify your aims. Do you want to exchange a pair of pieces, seize an important square, prevent some active undertaking by your opponent, or what? A logical examination of the position may suggest a direction for further analysis.

Choose the right order of playing moves.

In a winning position avoid complications. Look for forced variations.

Principles of rational, economical thinking

When thinking about your move, your task is not at all to calculate every variation to the end and attain an exhaustive understanding of the position.

You have one task, and only one: to make the correct decision, to play the best move.

As far as possible, try to minimize your expenditure of time and effort.

You should only calculate the minimum number of variations necessary for making the right decision.

How is this to be achieved?

1. What should you think about first?

It is usually sensible to start by examining the forcing moves such as exchanges, moves that win material, or the opposite – sacrifices.

2. The 'emergency exit'

In an obscure position it is good to see e.g. a forced perpetual check or a level endgame.

After this you can look for better possibilities.

3. Process of elimination

Sometimes there is no point in precisely calculating the line you intend to play.

You just need to conclude that the line makes some sense, that there is no immediate refutation, and that you have nothing better anyway – all other moves are bad.

4. Comparison

Sometimes a quick choice of move can be made purely on the following lines:

You realize that this move brings about a situation which is in no respect worse, and in some respect better, than the one you would obtain from a different continuation.

5. Don't spend too long analysing extremely complex variations – in such cases rely on your 'feel'

Sometimes obscure positions take too much time and energy. Could lead to time-trouble.

In what cases does it make sense to spend a lot of time thinking about a move? When you recognize the position is crucial for the rest of the game.

Dvoretsky advises: Don't restrict to this advice, evolve new principles for your own.

Study examples about taking decisions, solve exercises, analyse your games. This is not only about chess, but also useful for your life in general.

Reference:

GM John Nunn: The Tree of Analysis revisited

- Review Karel van Delft

In his book 'Secrets of Practical Chess' GM John Nunn heavily criticises the Tree of Analysis which Russian GM Alexander Kotov described in his book 'Think Like a Grandmaster'.

Kotov advised to start an analysis of a chess position with several possible moves. Each move could get several replies on which the first player again would have several possible moves to play. This leads to a structure of possibilities which can be compared with branches in a tree.

With only five realistic possibilities on each turn this would lead to 15,625 'leaves' after three moves. No problem for computers to come to an evaluation, but it is for humans.

Kotov advised to check each variation only once and analyse variation after variation, which also is criticized by Nunn. Kotov's method is extremely inefficient, concludes Nunn. You can for example analyse a variation for 20 minutes to come to a negative evaluation. Better is a quick scan of several possibilities. Then you can eliminate quite fast non-promising variations and concentrate on more promising lines of thought.

Another problem with Kotov's method is that it doesn't take into account the synergetic effect of several lines, Nunn says. Sometimes you find in one variation an idea which you can apply in another variation. That is why it sometimes is good to jump from one variation to another. Nunn: 'Spotting a new idea may even cause you to change your list of candidate moves.'

Also sometimes there are better methods than using the Tree of Analysis. Nunn mentions the 'goal-seeking' approach. He gives as an example the game G. Kuzmin – E. Sveshnikov, USSR Ch. Moscow 1973.

<https://www.chessgames.com/perl/chessgame?gid=1163173>



Nunn writes: 'You can never find a move like 16. Nb6 by using the tree of analysis (unless you are a computer) because it makes absolutely no sense except as part of the whole tactical operation, and therefore will not make it into your list of 'candidate moves'.'

Nunn concludes the Tree of Analysis is a useful technique in tactical positions, but it should be used flexibly and supplemented by other types of chess thinking.

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John Nunn, Secrets of Practical Chess, Gambit Publications Ltd, England 1998.

GM Rafael Leitao: No grandmaster calculates the way Kotov prescribes

- Review Karel van Delft

GM Rafael Leitao writes on his site about candidates moves:

<https://rafaelleitao.com/candidate-moves-technique>.

In his book 'Think like a grandmaster' GM Alexander Kotov was the first to mention the candidate moves technique. He recommended to calculate correctly via candidate moves and an analysis tree

via four steps:

- a) Select all interesting moves in a position
- b) Calculate them in an orderly fashion, without ever coming back to the beginning of the line
- c) Do the same for the opponent
- d) Draw conclusions for all lines

Leitao concludes that Kotov's view was very strict, and no grandmaster calculates this way. But, he thinks the concept is very useful to find ideas in positions with a lot of possibilities. He concludes Kotov's idea was revised and improved by authors like Dvoretsky and Aagaard.

Leitao asks himself how to actually use the candidate moves technique.

The best way to calculate in his opinion is the one recommended by John Nunn in his book 'Secrets of Practical Chess'.

First you should take a 'quick scan' of the position, whereby you analyse the most tempting lines and the most forced moves. In many cases this will already result in finding the best move.

In the most complicated cases, after this quick scan, you should go back to the initial position and, using the ideas studied in the quick scan, make a meticulous list of the candidate moves.

Leitao discusses a position in Kotov's book. He mentions not going back in variations prevents new ideas to be applied in a previously studied line.

References:

Site Rafael Leitao <https://rafaelleitao.com>

<https://rafaelleitao.com/candidate-moves-technique>

<https://rafaelleitao.com/legacy-mark-dvoretsky>

GM Johan Hellsten: As a human player, one has to be practical - Review Karel van Delft

On Chess.com GM Johan Hellsten wrote four blogs about candidate moves.

Hellsten defines candidate moves as moves worthy of consideration.

Hellsten distinguishes four cases related to candidate moves

- a) **Few candidate moves.** Defensive situations (king in check etc.), endgames.
- b) **Many candidate moves.** When we are attacking, chaotic positions etc.
- c) **Move orders.** We spot an idea, but only a correct move order will do the trick.
- d) **Secrets.** Only after having checked move "a" are we able to find move "b".

Each article relates to one of the four cases.

The cases are often intertwined.

In each blog example games are discussed.

Blog 1 Few candidate moves

The bad news: 'You might recall the following situation: after a game, you look at it with the help of an engine, and more than once, it asks for a move that you didn't even imagine during the game.'

The good news: 'Well, we will never be able to match the engine when it comes to sheer calculation, but at least we can try to surpass other humans at it!'



Position with a few candidate moves.

1. Kf3 leads to a draw. Only move.

Advice of Hellsten: It makes sense to practice this kind of calculation exercises a lot.

Consider always checks, captures and threats.

Blog 2 Widen focus

On other occasions, the candidate moves are harder to find. Sometimes, we must widen our focus from the main battlefield towards other zones of the board, in order to make the right choice.

Blog 3 Move orders

Good idea, bad execution? This is a common issue in everyday tactics. To make our ideas work, we must carefully consider the move order involved.

First impulses can be interesting but try to refute them. Find the logic on the board. And look for practical chances.

Blog 4 Secrets

Sometimes the best move cannot be easily found without first having checked another candidate move. The latter will lead us to some kind of secret in the position, which, no matter how trivial, holds the key to success.

GM Johan Hellsten: 3 is a great number

<https://www.youtube.com/watch?v=4Ma9gpdU3zs> (1 hour 11 min)

GM Johan Hellsten spoke with WGM Jennifer Shahade in a video about candidate moves.

She asked: How many candidate moves do you generally consider?

Hellsten: 3 is a great number.

He advises to anticipate moves of the opponent and prevent them.

It is important to have an open mind and look at different options.

Try to understand the plans of opponents.

How to improve? Key to success: Analysing your own games, each and every game you played.

References:

<https://www.chess.com/blog/jhellsten/candidate-moves>

<https://www.chess.com/blog/jhellsten/candidate-moves-ii>

<https://www.chess.com/blog/jhellsten/candidate-moves-iii>

<https://www.chess.com/blog/jhellsten/candidate-moves-iv>

GM Valeri Beim: When there is a choice of plans there is a choice of candidate moves
- Review Karel van Delft

GM Valery Beim wrote in his book 'How To Calculate Chess Tactics':
'In many complicated positions, when strategically things are not entirely clear, it is often very difficult to determine a single clear direction or dominant logic to the game. Then there is often a choice of different plans, and consequently, of candidate moves.'

Reference:

Valeri Beim, How To Calculate Chess Tactics, Gambit.

GM Jacob Aagaard: Before you can think, you need to learn how to see
- Review Karel van Delft

Candidate moves and ideas can be used as a simple technique to become more creative, GM Jacob Aagaard says.

The following quotes are from Chapter 2 Candidate Moves of his Chessable course 'Grandmaster Preparation: Calculation'

Alexander Kotov famously introduced the idea of candidate moves into chess literature in 'Think Like a Grandmaster'. The idea is simple and powerful. Rather than calculating endlessly on his first genius inspiration, Kotov suggested that the strong chess player would instead apply a bit of structure to his thinking and look for options first.

Kotov then went from this sound position to a land of trees and mechanical thinking that no one has returned to with their sanity intact. We shall not repeat this mistake.

Instead, we shall focus on candidate moves and ideas as a simple technique to become more creative. The idea is simple (as it should be). By focusing on looking for ideas that have not revealed themselves at once to our divine selves, we open up for our human ability to discover something new.

In my previous book on calculation, *Excelling at Chess Calculation*, I called the first chapter *Before You Can Think, You Need To Learn How To See*. This is what candidates are all about.

On his blog Jacob Aagaard had a lengthy discussion with his readers about critical moments in chess, which started with a letter by FM Amatzia Avni: <http://www.qualitychess.co.uk/blog/6113>

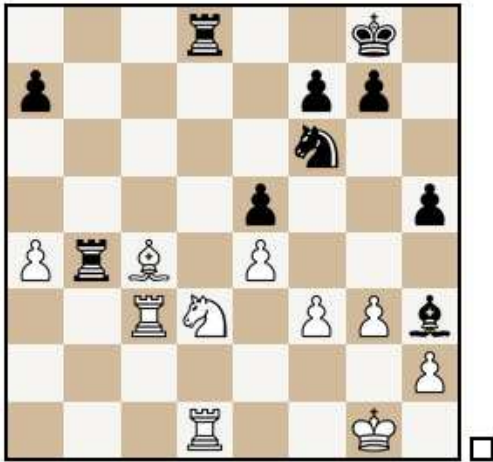
Reference:

Jacob Aagaard Grandmaster Preparation: Calculation

<https://www.chessable.com/grandmaster-preparation-calculation/course/16536>

GM Sam Shankland: Don't follow immediately your intuition
- Review Karel van Delft

From a book review on schaaksite.nl by Michel Hoetmer (in Dutch) about GM Sam Shankland 'Grandmaster Training Camp: Calculation'.



Vincent Keymer - Levon Aronian, internet 2022-2

FEN 3r2k1/p4pp1/5n2/4p2p/PrB1P3/2RN1PPb/7P/3R2K1 w - - 0 1

Keymer played 27. Rcc1?! Not too bad, but there is a better move.

The right move 27. Bxf7+ is a move an amateur checks directly, but the real reason only shows up a few moves later.

Following immediately your intuition can lead to disasters.

Reference:

Michel Hoetmer <https://www.schaaksite.nl/2023/04/17/recensie-grandmaster-training-camp-calculation-1>

GM Lev Alburt: How to think about a position

- Review Karel van Delft

In his 'Chess Training Pocket Book' GM Lev Alburt mentions five steps when thinking about a position.

1. Intuitively choose the candidate moves.
2. Start with the most appealing candidate move and analyze it. If there is a desired outcome, make it. If not, analyse the next appealing candidate move.
3. Keep mental notes. Discoveries in one variation may recur in other lines or lead to new candidate moves.
4. Try the brainstorming technique of reversing the move order if your intuition tells you there should be a forcing combination, but you don't find it in concrete analysis.
5. Before making a move, look again at it with fresh eyes.

Reference:

Lev Alburt, Chess Training Pocket Book, Chess Information and Research Center, New York 1997.



Black to move

IM John Bartholomew: Without candidate moves you will suffer a lot of defeats

- Review Karel van Delft

In every chess position there are candidate moves. Candidate moves are the moves you consider. If you play only the first move that comes to mind you will suffer a lot of defeats. You should limit yourself to a few promising looking candidate moves, you cannot consider all possible moves. Consider always forcing moves (checks, captures). In the position example there is no check, but there are three capture possibilities. Also move orders are important. Different move orders can lead to different results.

Reference:

Video 'Chess Training Tip #3: Candidates and Move Orders'

<https://www.youtube.com/watch?v=7-aTpOnroiE>

FM Amatzia Avni: The Grandmaster's Mind

- Review Karel van Delft

What can we learn from interviews with chess experts about candidate moves and connected issues?

Psychologist Amatzia Avni is FM and International Master of Chess Composition. In his book *The Grandmaster's Mind* (Gambit Publications Ltd. 2004) he tries to look inside the thinking-process of chess experts: grandmasters, a study composer, a problem-solver, and a trainer. With interviews Avni tried to penetrate the minds of chess experts. He doesn't pretend to do scientific research, because there was no control group and different players got different questions. 'I was merely seeking to acquire an insight, not a proof.' Although Avni doesn't use experimental methods he has an academic education and looks through the eyes of a psychologist. Although with limitations, the method of 'thinking aloud' is a well-known method of inquiry (compare De Groot). In the first part of the book Avni interviews experts, in the second part he tries to draw conclusions.

Avni says research has indicated that experts are able to recognize meaningful patterns of information unnoticed by novices. They organize their knowledge around core concepts and major principles that guide their thinking. Experts are also capable of flexibly retrieving important aspects of their knowledge with little attentive effort. They excel because they possess much knowledge, understanding, specific talent, and experience. Experts reach better and faster decisions and overall higher performance. A great deal of an expert's knowledge is tacit, they can't always articulate their thinking processes. Here we quote remarks and observations of Avni's interviewees, which have a connection with selecting candidate moves. We see different approaches by the grandmasters.

Interviews

GM Lev Psakhis:

'A grandmaster thinks in a more economical manner. He scans only major elements of the position, and examines just critical lines.'

'There are some moves which you can't explain. Either you feel them, or you don't.'

About taking decisions about approximately equal positions: 'I calculate variations and choose the one which appears the most promising.'

'Sometimes you have to use poetry, not mathematics.'

Sometimes you need an accurate analysis, sometimes there is nothing to calculate. 'The guiding principle is to be active.'

GM Alon Greenfeld

Where to concentrate your efforts? 'With the benefit of my experience, I am familiar with the vast majority of chess positions. I know what I should aim for.'

A will to find best moves and an attraction to brilliance can have an effect while making decisions. In case of a forced sequence it is worthwhile to check lines to the end; a good idea may emerge. Sometimes in order to reach a correct idea, you have to kill a wrong one.

GM Yona Kosashvili

A criterion for choosing moves is the degree they correspond to his taste.

'The basic idea, which guides your search, is based on what we call 'feeling', a hunch. But after that you must be sure that things are analytically correct.'

GM Alik Gershon

'In the majority of cases I can't articulate how I reach a certain decision. I rely on intuition.'

He tried to systemize his thinking, even by reading Kotov's model of how players should think.

'Whenever I try to understand, analyse, or explain why I play the moves I play (...) it interferes with my games and my results suffer.'

IM Alexander Mikhalevsky

'Basically a player should comprehend what a position consists of. He should be able to identify every positional element, like an open file, a passed pawn, weak squares etc., and evaluate it.'

'Understanding a position is the first step (...). Thereafter thinking revolves around three key issues:

1 What does my opponent want?

2 Where should I put my pieces?

3 Which pieces should be exchanged?

Based on the answers one forms a game-plan.'

The value of Kotov's model is limited. It might be useful in forced continuations. But even then in the course of the evaluation process other candidate moves might emerge.

'I advise my students to calculate each plausible variation just a little bit, to see if it is viable (...) and then to compare the results.'

'In the end, both kinds of reasoning, abstract and concrete, are required. But certainly verbal evaluations precedes analysis: sometimes you can solve all problems without concrete calculation.'

GM Gadi Rechlis

'The difference between grandmasters and average players is knowledge, experience and a feeling where things are heading.'

'The strongest players apply a practical thinking method.'

'I always ask myself: how can my opponent improve his position?'

'I am in no hurry (...) Human nature tends to reveal itself sooner or later – people collapse in difficult situations ...how long can one suffer and find 'only' moves?'

GM Boris Gelfand

'I can't always reconstruct how I hit upon a certain idea. Usually you get a general strategic or tactical direction, and then you seek how to implement it.'

'On some occasions you feel that an idea ought to be right for you, but you can't prove it; so you act on intuition.'

When he fails to detect good ideas Gelfand says he analyses every reasonable variation in a methodical way.

'Usually, if you don't see a move in the first few minutes, you are unlikely to see it at all.'

Speaking about his move 28. Nxc7 in Gelfand – Dominguez Moscow 2001, Gelfand says: 'I suppose that 28. Nxc7 didn't come easily because stereotyped thinking warns us against exchanging the powerful f5-knight for the miserable g7-bishop.'

That the unconsciousness plays a role as well becomes clear from Gelfand's words. Many bright ideas descend upon a player when their mind is floating, he says. He also found a solution in his sleep.

The mind goes on working, Avni concludes. Gelfand: 'Well, it happens quite often. GM Razuvaev advises his trainees that when they 're stuck, they should change something: go for a walk, get involved in another activity... Then, sometimes a solution suggests itself.'

An average game may contain three or four critical moments. That is when the game takes another course, e.g. by changing the pawn structure. Although in a tactical battle each move may be critical. Gelfand: 'In such situations I try to calculate as far as I can.'

Kotov's model of choosing candidate moves and screening each one thoroughly doesn't work, Gelfand says. 'During the searching process you find new ideas that escaped your first glance. Then you have to go back and search for new lines.'

Choosing between approximately equal moves you have to decide based on your style, feeling and opponent.

'If I can choose my move-order I'll choose one that preserves maximum flexibility for myself and leaves my opponent guessing at my intentions.'

GM Zvulon Gofshtein

In my younger days I used to search for the 'best move'. As I grew up, the more experience I gained, the better I understood that my aim should be 'to reach a good position'.

'When you feel that your position is good, that's where calculation should end. You shouldn't exert yourself unduly when effort is not required. Besides the risks of miscalculation, the time and energy involved might become more useful later in the game.'

'Sometimes, if you desire something badly, you don't see things.' Gofshtein refers to the Kabbalah.

GM Dov Zifroni

'I look for a game-plan. In some positions it might take quite some time to conceive a worthwhile plan. Then some candidate moves emerge.' As a very logical player he asks himself which pieces to exchange, gives attention to the pawn structure etc.

Often this gives problems playing against strong 'illogical' players who are very creative and original. Zifroni has a 'dreadful score' against GM Arthur Kogan.

GM Ilia Smirin

'Equal positions are toughest. If you are intent on winning them, you have to make concessions, to give something to your opponent. Emanuel Lasker was well aware of this. You have to weigh various factors and decide their worth.'

In some positions besides calculation the important factor is imagination: the ability to picture possibilities.

Psychology during a game is very significant, Smirin says. Queries like 'what moves would be unpleasant for him?' 'what is his mood?' or 'should I complicate matters for him?' are important.

Discussion

Seminal research about chess thinking is done by De Groot, Simon & Chase, Gobet, Saariluoma, and Charness, Avni states.

He summarizes their main findings:

1. Skilled players possess a large amount of chess-related knowledge.
2. This knowledge is organized in chunks (clusters of related information).
3. The excellence of strong players stems more from quick perception and powerful memory than from thinking further ahead (calculation).
4. Strong experienced players identify the essence of a position at a glance.
5. This identification is backed up by a huge storage of familiar patterns.
6. Strong players are much stronger than novices in restricting positions. The difference with random positions is much smaller.
7. Skilled players do not consider more candidate moves, but consider more effective moves.
8. Top players are faster and more accurate than intermediate players in choosing the best move.
9. Calculation of strong players is performed in a cyclic method of 'progressive deepening', first screening several candidate moves lightly, reverting to some of them time and again while

calculating, until a decision is made.

10. Neuroscientific research shows experts' thinking involves pronounced activation of different parts of the brain, which suggests experts use higher-order reasoning and make better use of their memory chunks.

It is difficult to draw specific conclusions about the thinking of grandmasters.

One methodology of inspecting chess players' cognitive abilities is eye-movement recording.

A novice would probably concentrate more on squares occupied by pieces, an advanced player more on vulnerable squares. The reasons why a grandmaster looks where they look is not self-evident.

The 'thinking aloud' method has serious shortcomings. E.g. not everybody expresses themselves well, they might not be aware of subconscious thoughts and verbal expressions might slow down the thinking process.

Avni makes some general observations:

1. Grandmasters always put the question What before the question How.
2. Grandmasters implement prophylactic thinking in a profound and systematic way.
3. Grandmasters manage their thinking in a focused and economical way.
4. Grandmasters employ logical reasoning.
5. Grandmasters validate their assessments against a host of subjective criteria.
6. Grandmasters adapt to changed circumstances quickly and effectively.

About the Grand-Plan Approach Avni observes GM's are often satisfied with mini-plans, consisting of a series of two to four moves.

References:

Avni, Amatzia, *The Grandmaster's Mind*, Gambit Publications Ltd. UK, 2004.

Avni, Amatzia, *Practical Chess Psychology*, Batsford, 2001.

GM Andrew Soltis: Being able to recognize candidate moves is an essential, time-saving skill - Review Karel van Delft

Chess players think in generalities (patterns, rules of thumb) but calculate variations, Soltis says in the beginning of his book 'The inner game of chess': The chessplayer looks a few moves ahead and makes a judgment about the various possibilities at their disposal.

Soltis says chess is not 99 percent tactics, but 99 percent calculating variations – the inner game of chess. Calculation is a skill that can be studied, learned, and sharpened.

Already on the first or second move a lot of mistakes can be made, Soltis shows.

He gives some advice. 'If we ask simple questions, we sometimes break down complex problems into their elements.' And: 'Sometimes you have to visualize the simplest positions of the board, mentally stripping away all but two or three key pieces in order to 'get it'.'

Visualization is essential, it is the power to consider positions that have yet to occur and to recognize the possibilities in those positions.

Soltis discusses various components of good calculation, such as the selection of candidate moves, the role of force, and the identification and evaluation of endpositions.

In most situations you don't have to visualize more than three moves ahead.

What lies behind calculation are ideas that count.

Much more important than calculating a long variation is the ability to properly evaluate a position at the end of a calculated sequence.

It is important to be aware of the possibility of tactical ideas in positions. You must be able to recognize them quickly. Pattern recognition is a key element in chess thinking, both tactical and strategic.

Like a scientist the player can ask the right questions to make inspiration easier, Soltis states.

Knowing many positions and plans are important, as is experience. 'Inexperience makes the most fertile imagination powerless', said Eugene Znosko-Borovsky.

Don't assume there is only one application of an idea. There might be several ideas at work in a position. Sometimes you can combine them. Each candidate move may involve its own tactical or strategic idea, or they may share a common idea.

The task of the calculator is to identify the candidates and determine which is best.

Best is to start with the most forceful candidate.

Being able to recognize candidate moves is an essential, time-saving skill. Humans can budget their time and develop intuition. Intuition is a skill which can be trained.

Candidate moves are a lot more personal than anyone likes to admit, Soltis criticizes Kotov.

You also should look for your opponent's candidate moves.

About the tree of analysis Soltis says there are three dimensions: length, breadth, and difficulty.

Soltis says grandmasters don't think more systematically than amateurs, they sometimes jump from branch to branch and back again. He quotes Mikhail Tal: 'To calculate sometimes all of the so-called 'tree of variations' is not simply difficult but impossible.'

Soltis refers to research by Simon Webb who found better players could come to accurate conclusions faster, thought in terms of concrete variations, and were therefore more efficient calculators.

Soltis says there is no perfect calculating method for all players. People think differently. 'In reality there is a strong element of serendipity in chess. When we look at one idea, we sometimes come up with another.'

About the mental processing of tree branches, there are four important questions:

1. What is the final position in each sequence like?
2. Am I sure they are the final positions?
3. Do I have the right move order?
4. Is there an escape route?

Compared with computers people have greater skills of intuition and evaluation. Soltis quotes Mikhail Botvinnik: 'A master's strength is in the evaluation of a position.'

A complication is that evaluation has a material component, but also a positional one. How to deal with material apples and positional oranges? When evaluating a seemingly forced line of play the position may reveal to us a superior alternative. 'And, as so often happens in chess, when you look, you find.'

How to reason? 'The moral is that you must not only evaluate a position correctly – you must evaluate the correct position.'

Soltis gives two general guidelines to the question 'How far is far enough?'

The first is to calculate as many moves ahead as it takes to reach a conclusion.

The second is to calculate until the forcing moves are over.

There are four basic rules when making choices:

1. Choices exist in every position, you always should look for alternatives.
2. There are pluses and minuses to each alternative.
3. There is no single criterion for making a choice.
4. Our opponents get to make choices too, we should try to limit them.

Soltis discusses six 'monkey wrenches' (disrupting aspects): (false) assumption, quiet move, destruction of guard (defender), zwihschenzug, attack-defense (opponent reacts with a threat of his own) and desperado.

Oversights will never disappear completely. There are simply too many causes, especially psychological ones. To reduce our oversights we have to recognize these causes.

Retreats (moving backwards to attack) are overlooked easily.

Perception aspects also play a role, such as 'the retained image', where one assumes a piece is still on a certain square when it isn't. Psychologist GM Nikolai Krogius described this phenomenon. Also there are optical illusions, e.g. when after a few moves in a variation a knight cannot make a fork because it is pinned. Also players sometimes don't look at the whole board and as a consequence

make a big mistake (e.g. Kasparov with white played Rxa4 and ended up losing after ...Qh6-c1+ in Kasparov – Petrosian, Moscow 1981).

Soltis gives several pieces of advice to avoid mistakes. Such as: explain your moves to an imaginary stranger. Or: If you see a good move, look for a better one. Also: Stop calculating in terms of moves and think in general terms about your own vulnerability.

Important is not only how to calculate, but also ask yourself when to calculate. Be pragmatic, only calculate when it could make a significant difference. Budget your time: Nimzowitsch: ‘The game of chess is a struggle. Not a mathematical exercise.’

Soltis ends: ‘The goal of every calculator should be to find the method most comfortable – and successful – for them. Calculation should be the key that unlocks the inner game of chess, and each person’s key is different.’

Reference:

Andrew Soltis, *The Inner Game of Chess*, 1994, David McKay Company Inc, USA

**GM Andrew Soltis: The wisest things ever said about chess
- Review Karel van Delft**

In this book Soltis describes all kinds of chess ideas in the form of maxims, wisecracks, proverbs etcetera. Some can be called ‘rules’, he writes in the foreword. The occasions when grandmasters follow the rules so vastly outnumber the times that they break rules, as a look at any grandmaster game plainly shows. Rules and maxims should not be used as a substitute for thinking. But they are wonderful as prompters to thinking. Good rules point in the right direction.

Several of the sayings in the book have more explicitly to do with candidate moves.

Chapter 14: The essence of chess is seeing the move after.

During Boris Spassky’s first World Championship match, former champion Mikhail Botvinnik asked him, ‘Do you always guess Petrosian’s moves?’ ‘Not always’, Spassky conceded.

Chapter 15: Masters don’t calculate more. They calculate better.

GM David Norwood: If anything, grandmasters often consider fewer alternatives.

GM Jonathan Levitt: Weak players spend more time considering weak moves, while strong players spend more time considering strong moves. (In: *Genius in Chess*)

Chapter 16: You’ll never become Alekhine if variations rule you, rather than the other way around.

IM Mark Dvoretsky: Do not calculate completed lines before you are absolutely sure it is necessary.

Chapter 19: Knowing when to calculate is just as important as knowing how to calculate.

GM Garry Kasparov: You have to realize when you are leaving the realm of what can be confirmed beyond a reasonable doubt. (In: *How Life Imitates Chess*).

Chapter 20: ‘Long variation, wrong variation’ is a quote by GM Bent Larsen.

GM David Bronstein: At first you see the position clearly. Within three moves it becomes somewhat like in a fog. And within five moves you only see the contours of the position.

GM Jacob Aagaard: The things you overlook in your long variation will seldom be as important as the move you overlooked at the start. (In: *Excelling at Chess Calculation*)

Chapter 28: When calculation of a move and its follow-up fails, reverse the order.

GM Lev Alburt: When your intuition tells you that there should be a forcing combination in the position, but your concrete analysis can’t make it work, try the brainstorming technique of reversing the move order. (In: *Chess Rules of Thumb*)

Chapter 48: In lost positions, use the process of elimination.

Simon Webb: When all the candidates before you look bad, reject the ones that allow your opponent a simple way to win. (In: *Chess for Tigers*)

Chapter 78: Evaluate without calculating.

GM Garry Kasparov: Suspending the game in time is a useful way to teach students how to evaluate qualitative factors such as a (pawn) structure and space. We do this by showing a chess position without revealing whose move it is. (In: *How Life Imitates Chess*).

Chapter 111: A move is made in four stages.

A.D. de Groot: Orientation, wide search for candidate moves, investigate each candidate, analysis to

confirm. Shorter formulated: orientation, exploration, investigation, and proof. (In: Thought and Choice in Chess)

Chapter 122: It's better to falsify your ideas than to verify them.

GM Jonathan Rowson about casting doubts on your candidate moves: The proper attitude is 'I'm not sure about Bf5, let me see if there's a flaw – rather than 'I like Bf5. I'll try to prove it works'. (In Chess for Zebras)

Chapter 123: The most difficult thing in the chess world is to choose one from among several apparently equally good moves.

Benjamin Blumenfeld: Play the candidate that is easiest to calculate.

Chapter 124: If you see a good move, look for a better one.

Attributed to many sources, from Damiano to Emanuel Lasker.

'I played this move rather quickly', GM Peter Svidler said of a move in a game against GM Garry Kasparov. The position was clearly superior but the game ended in a draw. In the analysis after the game he discovered he 'completely overlooked' a simple win.

Chapter 125: Reserve the greater option.

Cecil Purdy: If you have a choice between two candidates and one is a move you are likely to make in the next few turns anyway, play it. In that way you leave yourself with more options on the next move.

Chapter 229: Short term plans pay best.

Cecil Purdy: The average player will do best to rely on plans that are as short range as possible.

Reference:

Andrew Soltis, *The wisest things ever said about chess*, Batsford Chess, London 2008

IM Willy Hendriks Move First Think Later: There is no order in the way we look at the board - Review Karel van Delft



Variation Hendriks – Spanton, Hastings 2005/6 <https://www.chessgames.com/perl/chessgame?gid=1383886>

The most beautiful move in a game by IM Willy Hendriks. It was a pity it was an variation, and Hendriks didn't find the move. Fritz did. The move didn't win the game, but was the only continuation.

Improving in chess does not depend on implementing a few smart thinking methods, but mainly on building up a large amount of high quality chess knowledge. It is all about good moves. That is what IM Willy Hendriks states in his book 'Move First, Think Later'. He sees candidate moves as one of those smart thinking methods.

'Playing chess confronts us with the working of our brain.' When playing and training a lot of questions from the cognitive sciences automatically come to mind, IM Willy Hendriks writes in the preface of his book. He raises some questions like 'Can we make good evaluations by following some sort of to-do list?'. Also he asks if the attention for unconscious decision-making processes has some value for chess thinking. His book is intended as an inquiry into such questions. He gives a disclaimer: He doesn't intend to write a thoroughly scientific work. The book is mainly about improving in chess, and cognitive insights might contribute.

Hendriks states clearly that he thinks you can learn chess only by working with concrete positions, for example via solving exercises. The vision of Hendriks conflicts to a considerable extent with doctrines of mainstream chess didactics, he realizes.

Many chess books are based on the idea that you should not try out moves at random. First you should take a good look at the characteristics of the position and try to make a more general plan on that basis and only then search for a concrete move. Hendriks calls this approach pedantic and nonsense. 'No chess player thinks like this.' In fact it is the other way around, he states.

According to Hendriks, 'There is no order at all. We don't first judge the position and then look at moves. It all happens at the same time.'

The explanation is: 'You cannot have a meaningful characteristic of a position if it isn't connected with a (more or less) effective move.'

The 'dogma of the respectable order', as Hendriks calls it, is in his opinion an obvious but rather old-fashioned didactic conception. There is nothing wrong with a trainer who explains certain characteristics of a position, 'but it becomes patronising if you want to impose the order of 'judgment and plan' on your pupils.' 'This order can be reversed just as easily: effective moves steer us towards the essence of the position.'

Closely related to the dogma is 'the delusion of the lingual protocol'. Hendriks criticizes trainers and authors who think they can formulate all kinds of advice in words and that this can be applied in concrete positions and help players find the right move or plan. That way language in chess not only is descriptive but also prescriptive. Hendriks characterizes this advice as: Tell a story, connect it with an example of a position or game and suggest that is the way a grandmaster thinks.

The only way to answer questions like 'How do I create a weakness?' is: play good moves!

Proverb-like pieces of advice contain a grain of truth but can be replaced by others that are just as valid, or just as meaningless.

Hendriks is more of the school of the Dutch grandmaster J. H. Donner who described chess thinking as a 'sniffing-tactile perception'.

There are no magic words or descriptions to bring players to a higher level. 'Positions are not examples illustrating more general principles – they constitute the actual learning material!'

'If you cling tightly to generalities, you lose sight of the concrete.' A good way to improve therefore is hard work and the deep analysis of your own games.

If he is right in messing up 'the respectable order', Hendriks says, then there is room to revitalize a concept highly despised by traditional didactics: trial and error. So as the opposite to the 'search-and-solve' strategy as for example used by the Dutch IM Cor van Wijgerden in his Steps Method, in which he condemns 'guessing and missing'.

Trial and error is not necessarily random, Hendriks states. You start trying moves that for some reason feel most promising. In games and positions, it is clear pattern recognition plays an important role. 'What you see is what you know.' You see more if you know more, quantity is a quality.

In the second part of the book Hendriks delves more into the chess-playing brain and brain sciences. He admits he provokes in the first part of the book, but states humans don't know too much about how their own brains work.

The concept of pattern recognition is considered to be a basic mechanism in (chess) thinking. But we don't know very much about the ins and outs of that process. For a good overview Hendriks refers to 'Moves in Mind' by Gobet, De Voogt, and Retschitzki.

Hendriks defines pattern recognition as 'recognizing the similar', where visual stimuli play a major role (so no verbal-logical constructs). He notes: 'To my mind it is misguided to identify these patterns as the characteristics of the position, on the basis of which some intellectual activity (searching) produces moves.'

Remarkable is that unfamiliar or rare motives go unnoticed regularly, although variations can be short.

Hendriks discusses De Groot. His promotion study 'Het denken van den schaker' (1946), translated in 'Thought and Choice in Chess' (1965) is famous and groundbreaking.

To investigate the silent thinking of chess players you have to make it visible, or audible. Techniques

De Groot hadn't had at his disposal. He chose a technique called 'thinking out loud' which had some methodological issues, like unconscious thinking, not being able to formulate well, etcetera.

De Groot compared players of several strengths. His main conclusions are stronger players don't think deeper in variations compared with weaker players and stronger players saw much better and faster what positions are about, they know much more positions, patterns, plans, and combinations. Hendriks states that pattern recognition is only a psychological concept of what might be happening on a microscopic level in neurobiology, how brain cells work together. In the end our mind is the product of our material body.

The essence of a pattern is the meaningful relation between its parts. Knowledge about this is stored in our memory. But this is only half of the picture, Hendriks states, the other half being our active intelligence, our chess wisdom, strategic knowledge, understanding, calculation, and assessment. Hendriks refers to the science philosopher Karl Popper who introduced the idea that scientific progress is made by the process of falsification. Showing something to be untrue contributes more to knowledge than more examples supporting a theory (verification).

In chess literature falsification is almost absent, Hendriks states. Thanks to modern database technology more is possible now however.

'I see some coherence in the series of moves that pass my mind's eye, but is that the same as making a plan?', Hendriks asks. He discusses grandmaster Alexander Kotov, who is well known for his ideas about calculating variations. Hendriks calls his ideas too rigid and too systematic, e.g. his expression 'a bad plan is better than no plan at all.' Here Kotov shows being a representative of the Soviet ideology of plan economy, Hendriks says.

Games played according to a single plan are rare, so a game consists of a series of small plans. Seeing them as part of one total plan is nonsense, writes Hendriks. He states that by choosing his examples, Kotov reasons towards his conclusions.

And to stick to your plan is absurd. If you see a fault in your plan or more attractive moves you just should change plans.

Hendriks agrees with GM John Nunn: plans should be realistic (not too deep) and you should be flexible. He refers to the Dutch Steps Method, which paid attention to 'small plans'.

Maybe making plans is something for beginners, Hendriks says. They are not restricted by what is possible in (strong players') reality. The days of the romantics are over. We know much more nowadays, which brings restrictions in our 'possibilities': What you see is what you know.

Encouraging players to make plans is not necessary. 'Choosing from the possibilities that 'offer themselves' is more than sufficient.'

Also not wanting too much sometimes is a good strategy, Hendriks states. He gives an example of a game of his own (Hendriks – Langeweg, Bussum 1994). He couldn't find a good move, so he resigned. Had he only done nothing by playing his king between h2 and g2, the opponent couldn't make progress. This is what GM Jonathan Rowson in 'Chess for Zebras' calls the Taoist attitude.

'Doing nothing is so unnatural that you can forget that it is an option at all', Hendriks concludes.

It is strange we talk about 'seeing' combinations and 'making' plans, Hendriks says. He thinks making is often a matter of seeing. For that reason he states you should not learn to make plans, but instead should learn a lot of plans which you can use in games.

Concentrating on 'critical moments' can be misleading. A simple solution: be alert all the time.

In chapter 16 Hendriks quotes himself: 'Chess is solving too difficult problems in too little time.'

He agrees with GM John Nunn: 'Chess is all about making decisions. Postponing a decision does not necessarily improve it. Try to get in the habit of asking yourself: is further thought actually going to be beneficial?' Hendriks states it is clear one sees in the first minutes (or better, in the first seconds) the most important things. After 20 minutes one rarely sees better moves.

The concept of our consciousness as the controlling unit of our decision-making doesn't hold anymore, Hendriks states. At the same time he sees this notion is very alive in some chess manuals, advising to restructure your thinking process to improve your chess. An example according to Hendriks is psychologist FM Amatzia Avni's 'Practical Chess Psychology', which he describes as simplistic. Hendriks thinks it is wiser to feed 'the chess playing beast inside' with good chess.

Hendriks states about Avni: 'You can make up a psychological explanation for every mistake.' Name it stress, tunnel vision, he just missed 40. Rf3+, Hendriks wrote. 'Chess is a difficult game, so there is no reason to act as if mistakes are in principle unnecessary flaws in our thinking process.' Is it possible to improve our thinking process with some smart procedures? Hendriks discusses the techniques of blunder-checking and looking for candidate moves.

Blunder-checking comes down to have a fresh look at a position and check simple possibilities. Complementary to checking for blunders is taking some time and searching for candidate moves, Hendriks says. First take a fresh look and check for an attractive move. We often miss good moves, not because we dismissed them for some reason, but because we didn't see them at all.

The question must be asked if the benefits outweigh the time investment. Hendriks says to some extent you have to trust your sense of danger and your ability to spot attractive possibilities. 'If you try to incorporate all those protocolized smart things, you 'll end up with no time.'

'We all make mistakes, and for the biggest part they are simply the reflection of the level we are playing at.' Instead of taking 'protocolistic measures' as candidate moves, Hendriks advises to improve your chess 'by taking in good chess!'

Many chess books are concerned with the question of how to improve your chess the best way. What is the scientific value of different methods? There is a shortage of good empirical research, so people build up their own theories. They do this based on their own experiences as player and trainer, insights from different sciences, following other trainers, and advice by strong players. All of these can be valuable, Hendriks says, but they don't offer proof of the effectiveness of a certain approach. We have to content ourselves with this 'since good scientific research tends to be lengthy, extensive and expensive, and therefore not affordable for the chess world.'

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Willy Hendriks, Move First, Think Later: Sense and Nonsense in Improving Your Chess, 2012 New In Chess, Alkmaar, The Netherlands

IM Merijn van Delft review book 'Move First, Think Later': Speculation is a good start

- Review Karel van Delft

In a review on the Dutch internet site Schaaktalent.nl psychologist and chess trainer IM Merijn van Delft discussed the book. Here we mention some of his remarks.

Willy Hendriks' new book 'Move First, Think Later' was immediately the talk of the town. I think the book does cause some confusion.

The book is for the advanced chess player, for example it has nothing to do with school chess. When developing a skill (for example chess) you go through four phases:

1. Unconscious Unskillful
2. Consciously Unskillful
3. Consciously Skilled
4. Unconscious Skilled

With his book, Hendriks clearly focuses on the fourth phase of development. The difference between the different development phases is relevant on many points, for example when it comes to rules of thumb. Hendriks argues that all kinds of artificial (strategic) rules of thumb are better replaced by a concrete approach, in which the chess player (phase 4) calculates variants and is indirectly (unconsciously) helped by the chess knowledge they have built up. However, as a novice chess player (phase 1) you have no idea what to look for, you don't know much yet, and then it is very useful if your thinking is guided a bit by some rules of thumb. As you become stronger, you gradually let go of these artificial rules of thumb. The same applies to the blunder check (chapter 18). For the advanced chess player this is integrated into their thinking and something that usually happens unconsciously, for the novice chess player it can be an eye-opener and something to consciously work on. On many

points Hendriks creates a contradiction that may not exist.

The cover of the book suggests a solid scientific content, but in fact Hendriks' book does not go beyond the first phase of the empirical cycle: formulating hypotheses. There is nothing wrong with that, this also applies to Rowson's books, for example. Speculation about reality is a good start. Certainly challenging what the established order claims is very refreshing and makes the book fun to read.

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Review 'Move First, Think Later', September 14, 2012

<http://www.schaaktalent.nl/index.php/weblog-schaken-karel-van-delft/193-recensie-move-first-think-later-door-merijn-van-delft>

GM Michael Adams and Philippe Hurtado: Think Like a Super GM

– Review Can Kabadayi

Adams and Hurtado gave 40 puzzle positions ranging from beginners to Super GM's – and asked them to think out loud while analyzing and later give a solution followed by an evaluation of the resulting position. They even did eye tracking analyses of which particular areas they were looking at while analyzing.

The basic conclusion was that Super GM's very quickly find the very best move in any position – on average in around a minute. Then they spend a large amount of time analysing the consequences of that move, by actively trying to 'refute' that particular move, by looking at the opponent's best replies. They claim this is one of the biggest findings of this study – how long a GM takes to see how his favored move may not work. It is the opposite of wishful thinking which is common for beginners. Instead, the Super GM is a true scientist: he tests his hypothesis with evidence all the time and stays objective.

There is also an almost perfect correlation between one's Elo rating and the accuracy of the evaluation of the resulting position.

Another conclusion was strong players were basing their analysis mostly on concrete calculation rather than general principles, while weaker players were 'hand waving' much more, by justifying their move with general concepts and rules of thumb rather than concrete lines.

When it comes to candidate moves, they do not say too much. They mainly say strong players, using their expertise and large number of chess chunks, incredibly quickly reduce the possible candidate moves to 1 or 2 possible moves and quickly eliminate analyzing the weak alternatives. On the other hand, weaker players are distracted by more options on the very first move that may all look fine.

This leads to a loss of time and inefficient calculation. It takes much longer for weaker players to find the very best move – if at all - compared to masters. And if they find that best move, they usually do not spend much time trying to 'falsify' that move by looking at the best replies by the opponent.

They do not also show the relentless determination of searching for even a better option as GM's.

Masters have relentless determination to find the very best move in a position – a la Lasker's dictum, if you see a good move, look for a better one. Weaker players may settle with a move that looks good, without this determination to find even a stronger alternative for the first move.

Sometimes the move can be discovered simply by asking what the opponent wants to do. This question sometimes leads to obvious solutions that average players may not even consider after 15 minutes of thought. Perhaps this is one way of generating several candidate moves for the very first move. This prophylactic thinking may open new doors to a position and thus let players generate other candidate moves.

Prophylactic thinking also connects to reciprocal thinking: sometimes you do not consider one move as a possibility, but once you start analysing another move, you meet resistance (you discover a good resource for the opponent), and you discover another move while overcoming this resistance (e.g. you may say, that resource for the opponent would not work if my queen would be placed somewhere). Then you go back to the initial position and consider that other move (that queen to somewhere move) as a possibility.

Reference:

Michael Adams and Philip Hurtado, Think like a super GM, 2022 Quality Chess UK

GM Josh Friedel: They are not considering enough options

- Review Karel van Delft

How to train beginners in making choices during a chess game? GM Josh Friedel was interviewed by Ben Johnson on the Perpetual Chess Podcast. In the interview Friedel gives advice to beginners. That advice is valuable for trainers who want to teach how to generate candidate moves.

For experts like chess grandmasters, knowledge, insights, and skills are automatic. 'It just happens.' They don't think consciously about a lot of things.'

To teach chess to beginners asks for another perspective.

Friedel took a break from playing tournaments. While learning how to play guitar, he learned again to look via the eyes of a beginner. As a GM you see things automatically. As a beginner you have to look at things very basically. It should be simple. In chess you can bring it back to choosing among two choices. Preparing his Chessable course 'Beginner Mistakes and How to Avoid Them' Friedel went through a lot of Chess.com beginners' games. What struck him most was that many beginners played blitz. What do you learn from that?

Friedel chose for the course positions with common themes with a good and a bad solution.

Board awareness is important. Look which pieces and pawns attack and defend each other.

A lot is about habits, the routine to check those things. How can you do that in a blitz game?

What you do regularly becomes second nature and you do it automatically. That's why he let them repeat a lot. 'They get a bit sick of that.'

For Friedel's students rated above 1600, how they calculate is the most common problem. Friedel sees the same calculation problem at higher levels, for example at 2200. Players are just not considering enough options, he states. Also, the players analyse one variation after another. 'Like sticks, boom, boom, boom. There is no tree.' Quite often there is a mistake on move two, because players don't consider a move. Stronger players like himself, Friedel says, consider more options for candidate moves. You must look at all your options, not only the move that is in your mind. Especially young players quickly calculate a variation six moves deep and often like the outcome. Then Friedel regularly asks them 'but what happened at move two?' Like with learning to play the guitar, you must slow things down to make them manageable.

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Friedel is author of the Chessable course 'Beginner Mistakes and How to Avoid Them'

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Perpetual Chess Improvement, Ben Johnson, New In Chess 2023

<https://www.newinchess.com/perpetual-chess-improvement>

GM Stefan Kindermann: Backwards thinking is a powerful tool

- Review Karel van Delft

Backwards (reversed) thinking is a powerful tool when choosing the best move. It means analysing a chess position starting with an end position in mind. GM Stefan Kindermann and GM of chess composition Robert K. von Weizäcker describe a chess thinking method in their book 'Köningsplan' (Kingsplan) in which they combine logically structured thinking with intuition.

To make backwards thinking work, the precondition is that a clear goal/vision exists and we can go backward from there, Kindermann replied to a Chessable science team questionnaire. This goal/vision in chess is linked with patterns (strategic or tactical) with stronger players obviously having much more of them stored in their (intuitive) knowledge.

Kindermann believes it can be very useful for stronger players to put the focus on a more conscious use of backward thinking. For weaker players it can be only useful, when they enlarge their patterns, which are necessary to create the goals to start from in backwards thinking.

Kindermann says the most crucial point is to use forward and backward thinking in combination. 'Which at a subconscious level in my opinion stronger players do to some extent without realizing it: We start from candidate moves to search forward, while at the same time we are striving to reach some kind of goals and come to the question about the obstacles along the way which leads to the question "what has to happen before these obstacles can be removed". Used in the right way, the combination of backward and forward is the most powerful thinking tool, as pointed out in the "Königsplan", an approach that can be used for planning and decision making in general!'

In the questionnaire Kindermann agreed with the presentation about reversed solving via a short video by GM Artur Yusupov. His whole response can be found via the link to the report 'Reflections on reversed thinking in chess'.

The link to the video with GM Artur Yusupov in the original research paper doesn't work anymore but the video is at <https://www.youtube.com/watch?v=RhK8DGFYpAg>

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SCIENCE AND PSYCHOLOGY

- By Karel van Delft

There is no specific scientific research done about candidate moves and chess. But there is a lot of other psychological research which applies to chess. Science and in particular psychology have a lot to offer for chess training and playing.

This research paper is about chess and decision making and in particular using the method of candidate moves. However, a few words about science and psychology in general might give context to our candidate moves study.

Science describes, explains, predicts, and influences phenomena. It is based on a paradigm: a framework of theories, methodologies, and assumptions. A paradigm shift is necessary when scientific explanations don't work. Psychology studies thinking, feeling, and behaviour of people. Everything the brain does is psychology.

There are many applications of psychology possible to chess. Psychology can offer insights in information processing and self-management:

Attention, Brain functions, Calculation, Cheating, Coaching, Cognitive biases, Cognitive restructuring, Communication, Consciousness, Concept formation and categorization, Cooperation, Concentration, Creativity, Decision making, Deliberate practice, Development, Emotions, Expertise, Goal setting, Heuristics, Intelligence, Intuition, Knowledge, Language, Learning, Memory, Metacognition, Motivation, Nature versus Nurture, Organization, Pattern recognition, Perception, Personalities, Problem solving, Rationality (bounded), Reasoning, Resilience, Role models, Search strategies, Self-management, Self-reflection, Skills and competences, Social cognition, Social interaction, Stimulating culture, Storytelling, Teaching, Thinking processes, Transfer, Visualizing.

How to apply scientific knowledge to practice?

Reflect on insights and experiences with a growth mind-set.

Develop thinking and behaviour routines.

A useful tool is a diary with insights. You verbalize, reflect, learn actively, and can repeat.

A great breakthrough in chess and psychology was created by the Dutch psychologist A. D. de Groot with his book 'Het denken van den schaker' (1946), translated in English (1965) as 'Thought and Choice in Chess'. De Groot made clear that pattern recognition is the basis of chess thinking.

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Christopher Chabris about Kotov

- By Karel van Delft

Professor of cognitive psychology and national master Christopher Chabris talked with Ben Johnson on his Perpetual Chess Podcast (February 21, 2020) about the book 'Think Like a Grandmaster' by the Russian GM Alexander Kotov. The book was written in 1971. The book is a classic in chess literature. Kotov researched thought processes and decision-making methods of grandmasters. Key concepts in the book are the tree of analysis and candidate moves. Using them leads to a systematic, methodological way of evaluating move options in a chess position, says Kotov.

Kotov advised to only check variations once. This idea was later criticized by important chess authors, as described elsewhere in this research paper. Chabris agrees with them, but states besides the rigid ideas about the tree of variations, the book gives good advice and has instructive material in it.

Chabris points out that Kotov was a pioneer in the chess literature by researching thinking processes of chess players rather than analysing chess technical issues. Insight into their thinking gives players more of a grip on their development and performance in games. Mainly the first chapter of Kotov's book made a big impression in the chess world. The first chapter is about analysis of variations and selecting candidate moves.

The candidate move idea is of much more importance than the tree of analysis, Chabris states.

He refers to IM Mark Dvoretsky who in the book 'Attack and Defence' mentions three reasons why candidate moves are very useful, although they don't work all the time. Candidate moves: 1. Help with surveying variations rationally and structuring your thoughts, 2. Help with time-management and 3. Help discover resources you didn't suspect at the outset (an idea found in one variation might fit well in another variation).

Ben Johnson had an earlier podcast interview with Christopher Chabris (October 9, 2018), who is well known for his research with Prof. Daniel Simons about 'inattention blindness'. They made the YouTube video 'the invisible gorilla'. Half of the people don't see the gorilla if paying attention to other things and not expecting something strange to happen.

Connected with inattention blindness is 'change blindness'. Chabris did such experiments while doing his PhD on chess and cognitive psychology. In 1999 he received a PhD degree in psychology from Harvard University, with a thesis titled 'Cognitive and Neuropsychological Mechanisms of Expertise: Studies with Chess Masters.'

Chabris mentions that it is almost always overdone when people appeal to neuroscience to explain how you should study chess, which functions are involved etcetera. You should look at what works, unless there is very solid evidence for such claims.

Important while learning, he says, is asking the Why-question. If you understand you remember better and can use the theme in similar situations. 'Playing is the best learning. You have to do all the stuff.'

Not for everything you need a randomized experiment, for example in regards to the question if a parachute is helpful when you jump from a plane. It is obvious that to become a good chess player you have to play a lot of games. There are no counterexamples that indicate something else.

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Do GMs see the board differently? What does vision science and cognitive science say?

- By Benjamin Balas

What makes stronger chess players more capable of finding the best move in a given position? One proposal is that stronger players' perception of the pieces arranged on the board differs from that of weaker players, but what exactly does this mean? If you're a chess player, you've probably heard people talk about "pattern recognition" or "calculating" as skills to build up to improve your own board vision. The thing is that if you're a vision scientist or a cognitive scientist it's not immediately clear how those terms relate to the stages of processing we think about in the mind and the brain. Thankfully, there are a number of studies that have tried to characterize how strong players may see the board differently in terms of specific visual and cognitive processes. What do those results reveal about how one's perception of the board may change as you grow stronger?

Dr. Adriaan de Groot is responsible for one of the most well-known results in this area, which is still widely taught in courses that focus on human memory and learning. In his book "Thought and Choice in Chess," De Groot (1946) describes a simple experiment in which he asked a small group of GMs to try and remember a position and compared their performance to weaker players who were asked to do the same thing. In this task, GMs proved better able to recall the position accurately than lower-rated chess experts. Later work by Chase and Simon (1973) used a similar task, but with the inclusion of an important control condition: Target positions that were randomly shuffled rather than resembling coherent positions emerging from a game. In their study, stronger players again proved better at accurately recalling chess positions, but this advantage was much smaller if the arrangement of pieces on the board was random. This outcome indicates that GMs likely don't have overall better memory than weaker players in general. Indeed subsequent work examining visual memory for shapes as a function of playing strength revealed no relationship between the two (Waters et al., 2002). This suggests that strong players are able to apply some sort of efficient strategy to encode or recall familiar arrangements of pieces - possibly by grouping pieces together into meaningful chunks (e.g., a castled king with a fianchettoed bishop) or by leveraging the contents of long-term memory (Gobet & Simon, 1996) to further reduce the load associated with a complex position.

These studies examining the visual memory of GMs and other expert players for chess position remain important demonstrations of how expertise can shape aspects of cognition, but they don't answer a key question: Do strong players somehow *see* differently over-the-board, or do they remember chess positions differently? To characterize perceptual processing - seeing the board - independent from memory, we need to use different tasks to assess the visual processing employed by players of different strengths. To that end, there are a number of interesting results that suggest strong play is indeed associated with different perception of the chessboard. An early eye-tracking

study (Jongman, 1968) highlighted the tendency of stronger players to avoid looking at familiar patterns in chess positions, focusing instead on portions of the position that were of important strategic value. De Groot and Gobet (1996) expanded on this result, demonstrating that during a memory task, experts avoided long fixations on parts of the board they described as “normal” and instead looked for more time at portions of the board that were relatively novel. Though eye movements are not a perfect proxy for how visual attention is deployed, this nonetheless suggests that increased familiarity with chess positions (possibly associated with the acquisition of a library of familiar chunks of pieces) leads some parts of the board to be inspected for much less time than others and by extension, possibly to a summary of the position in terms of these familiar chunks and a richer description of the deviations from what’s normal or familiar. An important result that more closely targets visual attention differences in experts and novices made use of a standard paradigm in vision science research: The “flicker” task. In this methodology, observers are presented with two alternating images that are either identical, or which may differ from one another due to the absence of some small element or a change in the position of an element. Detecting whether a change is occurring between image alternations or identifying what that change is can be very difficult (Rensink et al., 1997), suggesting that the visual summaries of scene contents can elide enough detail that detecting small changes is challenging. On the other hand, if some changes are detected more easily in this paradigm, this is an indicator that this portion of the scene was attended to more carefully and with more fidelity. Using this paradigm, Ferrari et al. (2008) demonstrated that expert players were both better able to detect differences between chess positions than novices, but also were better able to detect differences associated with developed pieces compared to undeveloped pieces. This is a simple demonstration that stronger players do in fact see more than novices over the board (at least during brief glimpses), and what they see with more fidelity depends on the strategic value of pieces in the position.

Considered together, these results suggest that stronger players perceive chess positions in terms of a visual summary that differs from that of weaker players. Whether you’re a chess expert or not, you use visual summaries like this too when you look at complicated scenes (Rensink, 2018), but chess expertise leads to a specialized visual vocabulary for summarizing board configurations. That vocabulary, which appears to involve neural mechanisms for perceiving patterns at a large spatial scale as well as access to positions stored in long-term memory, supports better recall for chess position, differential deployment of visual attention over the chessboard, and better discrimination between subtly different chess positions (Roth, 1983).

An important point, however, is that we must be careful about whether *different* perception will always translate into *better* performance! The ability to quickly summarize a chess position using a library of familiar perceptual chunks and thus deploy attention to the board differently certainly sounds good, but may also lead strong players astray in some circumstances. The “Einstellung” effect refers to circumstances in which familiarity with a problem can lead to a familiar solution interfering with the achievement with a better one. Bilalic et al. (2007) found that this interference effect is evident in expert players, such that the true best move in a given position could be missed when a familiar alternative was evident - an interference effect that dramatically lowered their nominal rating for the task! Greater expertise tended to reduce this interference effect, but this nonetheless demonstrates that while domain expertise and its associated effects on how the board is perceived can be both a boon to the expert player (strong players generally know what to ignore) and an occasional curse (sometimes you ignore something that matters!).

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ONLINE TEST HYPOTHESIS

- by Laszlo Moldovan, Johan Hellsten, Can Kabadayi, Karel van Delft

The screenshot displays a web-based chess quiz interface. At the top left, it says "ChessQuiz". The main area is titled "Practice 1 of 2" and shows a chessboard with a white king on e1 and a white rook on h1. The board is labeled with ranks 1-8 and files a-h. Below the board, it says "You are playing as black". To the right of the board, there is a "Solution" section with the text "1... Bh3 2. Rc1" and a "Message" section with the text "Please continue..." and a "Next" button. At the bottom of the interface, there is a copyright notice: "© 2023 - ChessQuiz by Schaakacademie Apeldoorn About".

Practice 1 of 2

Solution

1... Bh3 2. Rc1 Bg4 3. Qe3 Nf3+

Candidate moves

After providing the solution, you are required to provide two other candidate moves (first move only!).

Second candidate: 1... c5

Third candidate:

Message

Please provide your third candidate move.

Next

You are playing as black

Hypothesis

Chess players make better decisions if prompted to consider candidate moves compared with players who are just asked to find the best move.

Definition Candidate Moves

Candidate moves are the moves that deserve attention in a given chess position.

To explore this hypothesis we developed an online test with tactical positions in English.

This was done via ChessQuiz, a program developed by Laszlo Moldovan (copyright Chess Academy Apeldoorn).

Potential participants were told the research is about decision-making in chess, how well people solve different kinds of chess puzzles, and how fast. So we disguised the search for the possible effect of using the candidate moves method while solving.

There were two versions of the test.

In the experimental condition participants were asked explicitly to use the method of candidate moves. This was explained by giving our definition of candidate moves.

In the other condition they were asked to play the best move.

Participants were divided in two conditions based on their FIDE rating. We used the ABBA schedule: highest and fourth rating in A, second and third in B, etcetera.

In both conditions were the same puzzles. Two puzzles to practise and ten to solve. The puzzles were selected from training material by workgroup members GM Johan Hellsten and CM Can Kabadayi.

Criteria for selecting puzzles were:

- Tactical (not positional)
- No puzzle goes deeper than three moves
- Only puzzles where candidate moves thinking pays off highly
- Several difficulty levels
- Two backwards attack positions (sub-research: cognitive bias)
- Positions are selected by experts (GM Johan Hellsten, CM Can Kabadayi)

For each puzzle the participants got maximum five minutes. This was visible via a timer.

In the experimental condition participants were asked, after solving each position, to mention two other candidate moves. By asking them to mention two other candidate moves after each puzzle, we wanted to stimulate using the candidate moves method.

We asked participants for short variations. With one move solutions the risk of 'lucky shots' is higher. ChessQuiz reacted on moves from participants by programmed moves. In case of more comparable moves GM Johan Hellsten chose a human-like programmed answer, not a computer line.

The tests' results included solving scores and used solving time. These results could be compared with the rating of the participants.

Also the results between the experimental and the control condition could be compared. And we could compare results within each condition, when we divided the participants later into four rating level groups.

Participants were recruited via social media, newsletters, websites, etcetera.

They were asked to register via a link and to answer questions about their name, FIDE ID, FIDE Elo rating, FIDE title, Year of birth, Gender, Nationality, Chessable username, Email address and the possibility to get an one month Chessable free PRO account.

Two of the puzzles involved a 'backward attack', so a piece went backwards in order to make an effective attack. Backward attack positions are what we considered to be a cognitive bias positions, since mostly people associate attack with moving forward.

The puzzles and the correct solutions can be found in this gameviewer:

[Gameviewer puzzles Chessable test Decision making in chess](#)

The first two puzzles were for practice and their results weren't counted in the scores and analyses.

After solving 10 puzzles, participants had the option to answer some open-ended questions. Not everyone wants to write about their opinions or is skilled to do. The reason to ask optional, open-ended questions is to get more insights, opinions, experiences, and suggestions.

Intro texts for both conditions in ChessQuiz:

Experimental

You get five minutes to solve each puzzle. After you make a move by putting a piece or pawn to another square the ChessQuiz program will respond with a move. Then make the next moves until the program shows the puzzle is solved. If you make a mistake the next puzzle will be presented. The first two puzzles are to get used to the solving method; they won't be counted for your total score. You cannot take moves back.

We ask you to use the method of candidate moves. This means you look at the puzzle and select three moves which look most promising. After you checked those, pick the candidate move and variation you think is the best.

Control

You get five minutes to solve each puzzle. After you make a move by putting a piece or pawn to another square the ChessQuiz program will respond with a move. Then make the next moves until the program shows the puzzle is solved. If you make a mistake the next puzzle will be presented. The first two puzzles are to get used to the solving method; they won't be counted for your total score. You cannot take moves back.

We ask you to concentrate well and solve the puzzles.

Questions after chess puzzles via link to Typeform questionnaires

In the experimental condition we ask after the last puzzle:

These questions are optional, but we would appreciate your answers which will be processed anonymously.

Did you know the candidate moves method before?

How useful do you think it is?

Do you use other methods for your search strategy and if so which?

Do you want to add anything to this?

In the control condition we ask after the last puzzle:

These questions are optional, but we would appreciate your answers which will be processed anonymously.

Can you tell us what kind of search strategy you use when you solve this type of puzzle?

Do you want to add anything to this?

Results of ChessQuiz and the registrations via a Typeform questionnaire were put in Excel files. The Excel files results were analysed.

Main question: Is the hypothesis confirmed? (Significance level $P < 0.05$)

Second question: Do we find differences between the two conditions in the same rating level intervals? Do we find differences in each condition between Elo interval levels?

The number in a rating interval should be for $P < 0.05$ at least 20 in a group.

So with at least 160 participants we could have in each of two conditions four interval groups.

Because in practice the number of participants could differ between conditions and in conditions between rating levels, we should try to get more.

In an article (Chapter 1.3) by Hurtado in the book 'Think Like a Super-GM' by Michael Adams and Philip Hurtado the latter found significant performance differences between rating level groups per 200 Elo points difference.

Participants use all kinds of search strategies (some including using candidate moves), such as acronyms, first check for danger, using checklists (king safety, pawn structure, etc. etc.). This is always the case in research and effects will average out between the two conditions.

Important is: Do the groups differ on the manipulated variable, which is the explicit question in the experimental condition to use the candidate moves method.

Responses

In six weeks we got 551 registrations. There were double registrations, try-outs, nonsense reactions, no-FIDE rating, no FIDE standard Elo rating. Eventually we got exactly 350 usable registrations.

Those participants got links to either the experimental test or the control test.

There were 207 people who completed the test: Experimental condition 97, Control condition 110.

There were 18 people who didn't complete the test: Experimental condition 11, Control condition 7.

The open questions were answered by 68 participants in the experimental condition and 74 in the control condition.

To compare ratings of participants with scores, we asked for a FIDE standard Elo rating.

TEST RESULTS

- By Dries Wedda and Benjamin Balas

1. Population statistics

We consider gender, age, FIDE standard Elo rating, nationality, and FIDE title.

1.1 Gender

There were 207 participants (187 male, 19 female, 1 other). The experimental group had 97 participants (89 male, 8 female), the control group had 110 participants (98 male, 11 female, 1 other).

1.2 Age

The mean age of all participants is 38.6 years. The age distribution can be seen in Figure 1.

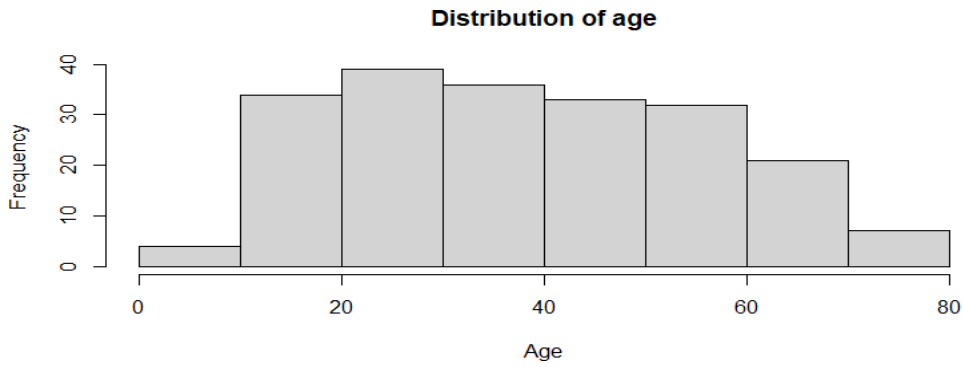


Figure 1: Distribution of ages for all participants.

The mean age in the experimental group was 39.4 years, whereas the mean age in the control group was 38.0 years. The age distributions are visible in Figure 2 and Figure 3.

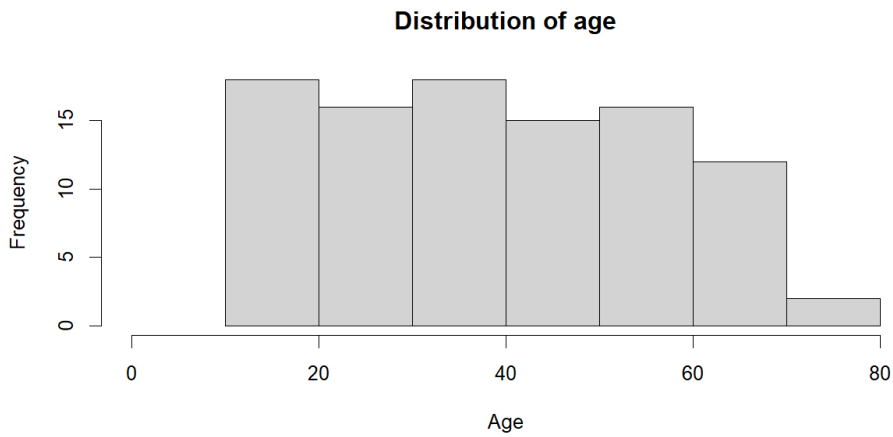


Figure 2: Distribution of ages in the experimental group.

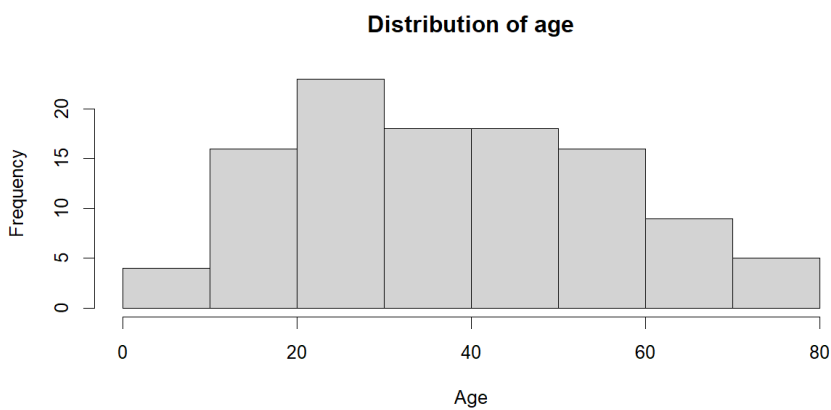


Figure 3: Distribution of ages in the control group.

1.3 Rating

Combined Mean rating: 1844. For distribution, see Figure 4.

Distribution of FIDE standard Elo ratings

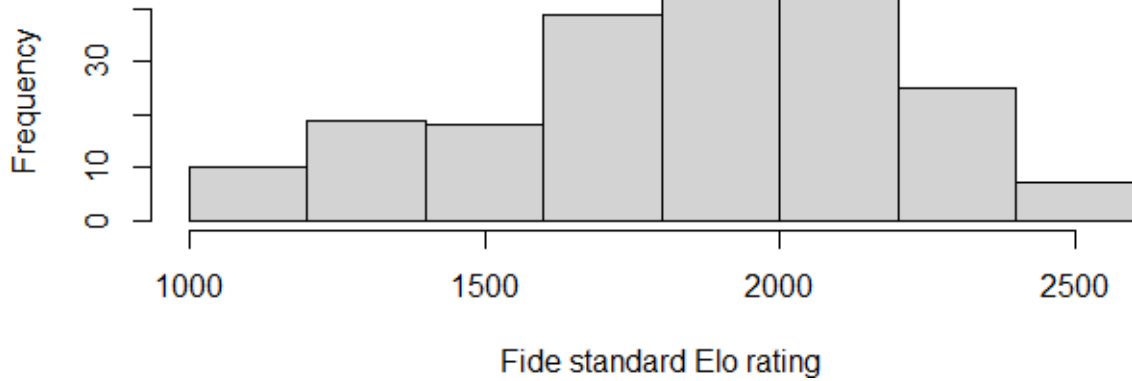


Figure 4: Distribution of FIDE standard Elo ratings of all participants.

Experimental Mean rating: 1857. For distribution, see Figure 5.

Distribution of FIDE standard Elo ratings

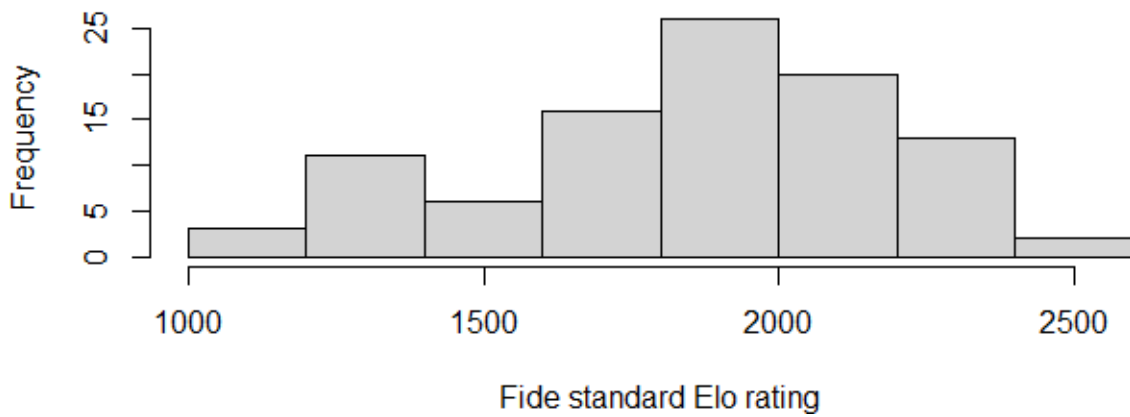


Figure 5: Distribution of FIDE standard Elo ratings of participants in the experimental group.

A Kolmogorov-Smirnov test suggested that there is no significant difference in the rating distribution of both conditions ($D=0.0083$, $p=0.87$).

Control Mean rating: 1832. For distribution, see Figure 6.

Distribution of FIDE standard Elo ratings

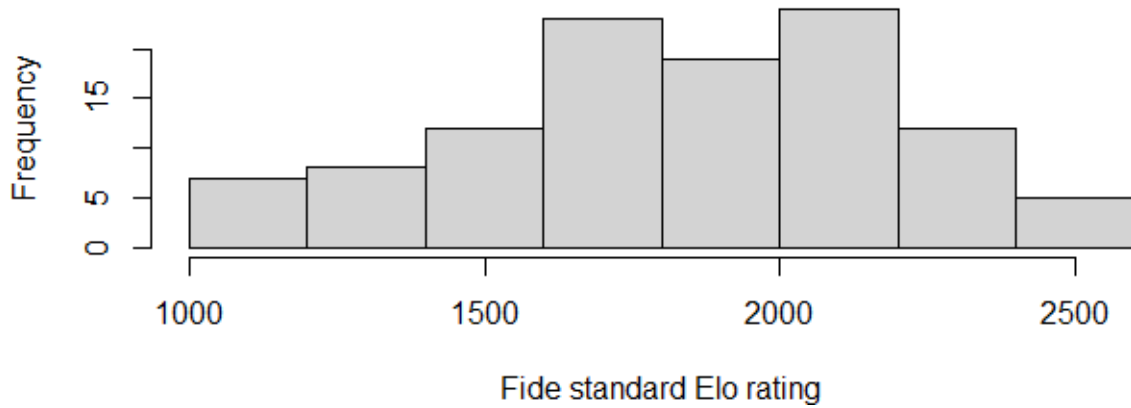


Figure 6: Distribution of FIDE standard Elo ratings of participants in the control group.

1.4 Nationality

Participants from 41 countries participated.

Nationality / Country	Count	Nationality / Country	Count	Nationality / Country	Count
Netherlands	62	Bulgaria	3	Ghana	1
United States of America	14	France	3	Greece	1
Germany	12	Sweden	3	Iceland	1
India	10	Switzerland	3	Latvia	1
Italy	10	Turkiye	3	Malaysia	1
Sri Lanka	10	Denmark	2	Mexico	1
Spain	9	Guatemala	2	Namibia	1
Canada	8	Hungary	2	Peru	1
Belgium	7	Israel	2	Portugal	1
England	7	Russia	2	Singapore	1
Austria	4	Scotland	2	Slovakia	1
Brazil	4	Argentina	1	Slovenia	1
Norway	4	Australia	1	Zimbabwe	1
Poland	4	Colombia	1		

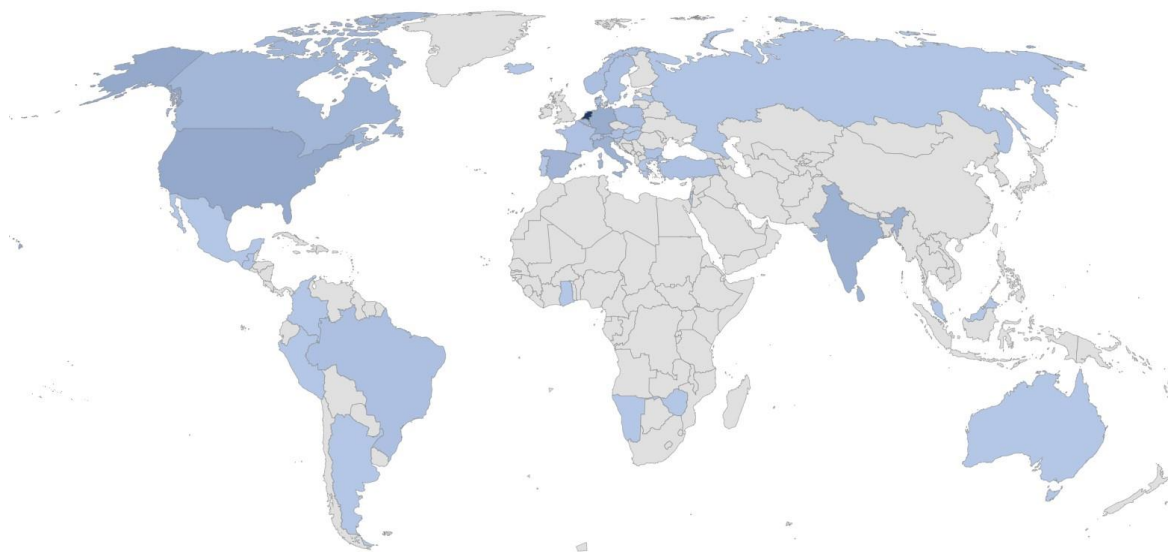


Figure 7: Map of all nationalities of participants.

1.5 Title

title	count
GM	5
IM	9
FM	17
CM	3
WGM	1
WIM	2
WFM	1
WCM	1
No title	168

Table 1: FIDE titles of all participants.

title	count
GM	1
IM	3
FM	12
CM	3
WGM	1
WIM	1
WFM	1
WCM	0
No title	75

Table 2: FIDE titles of participants in experimental group.

title	count
GM	4
IM	6
FM	5
CM	0
WGM	0
WIM	1
WFM	0
WCM	1
No title	93

Table 3: FIDE titles of participants in control group.

2 Correlations

2.1 Score and rating

A Spearman correlation test indicated that there was a strong positive correlation between FIDE standard Elo rating and the test score, for both the experimental condition ($\rho = 0.57$; $S = 65447$, $p < 0.001$) and the control condition ($\rho = 0.64$; $S = 80578$, $p < 0.001$). The scatter plots for the experimental group and the control group are visible in Figure 8 and Figure 9, respectively. In the experimental group, participants used 66.2 seconds per puzzle on average, whereas in the control group, participants used 69.9 seconds per puzzle on average. Each group had the same ten chess puzzles to solve.

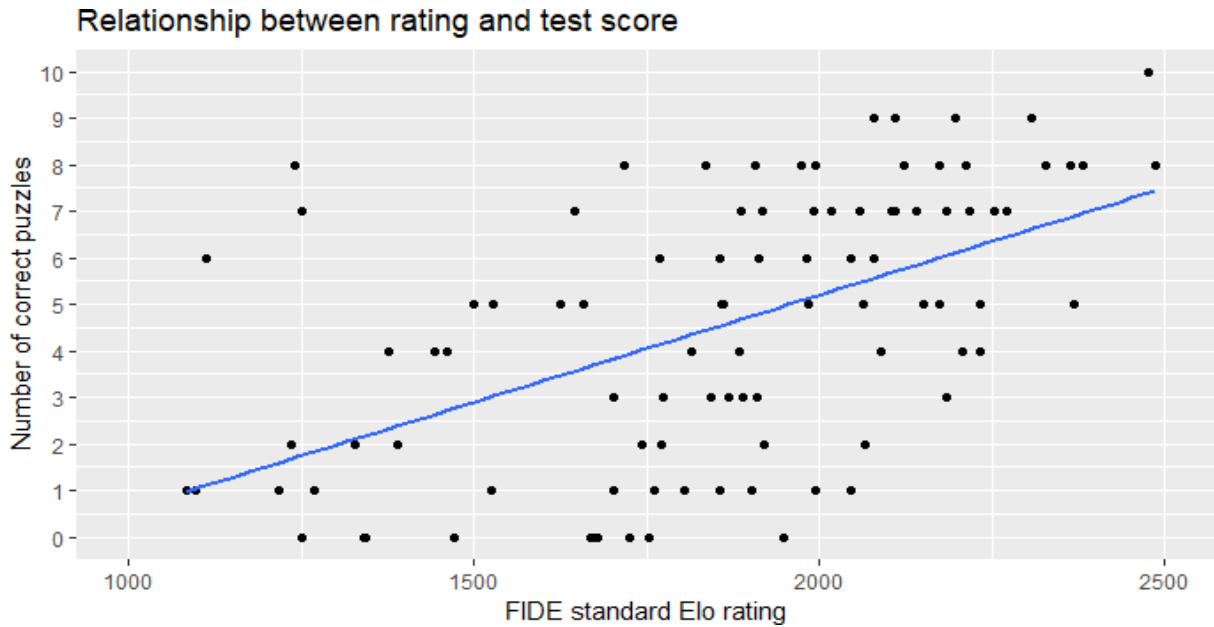


Figure 8: Relationship between FIDE standard Elo rating and test score in the experimental group.

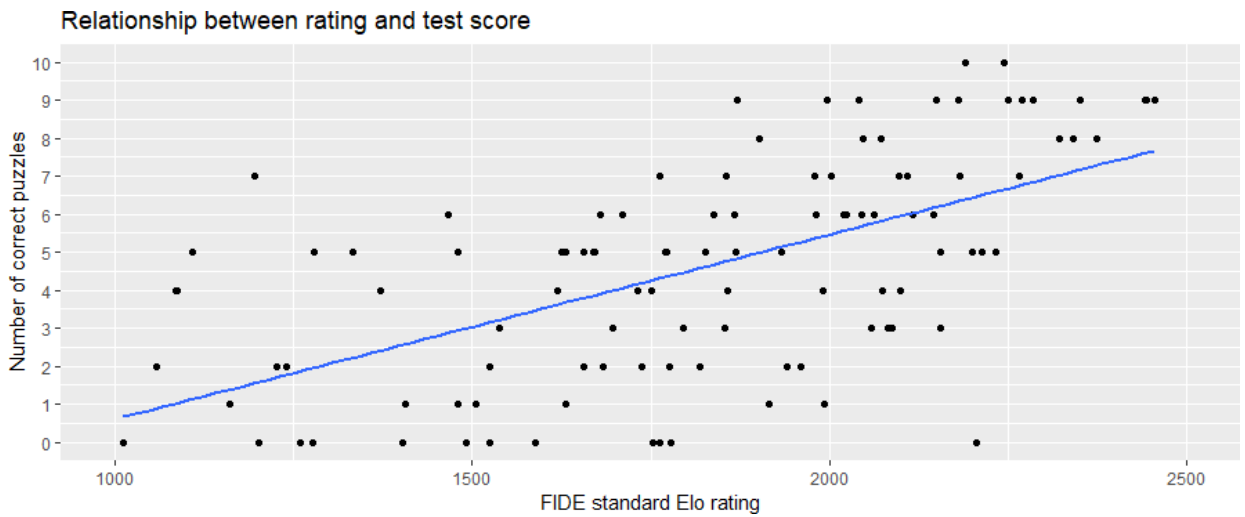


Figure 9: Relationship between FIDE standard Elo rating and test score in the control group.

2.2 Rating and time

A Pearson correlation test indicated that there was a small negative correlation between FIDE standard Elo rating and the mean time used for correctly solved puzzles, for the control condition ($\rho = -0.27$; $t(96) = -2.755$, $p = 0.007$). For the experimental condition, the Pearson correlation test did not indicate that there was a significant small negative correlation ($\rho = -0.11$; $t(85) = -1.009$, $p = 0.32$).

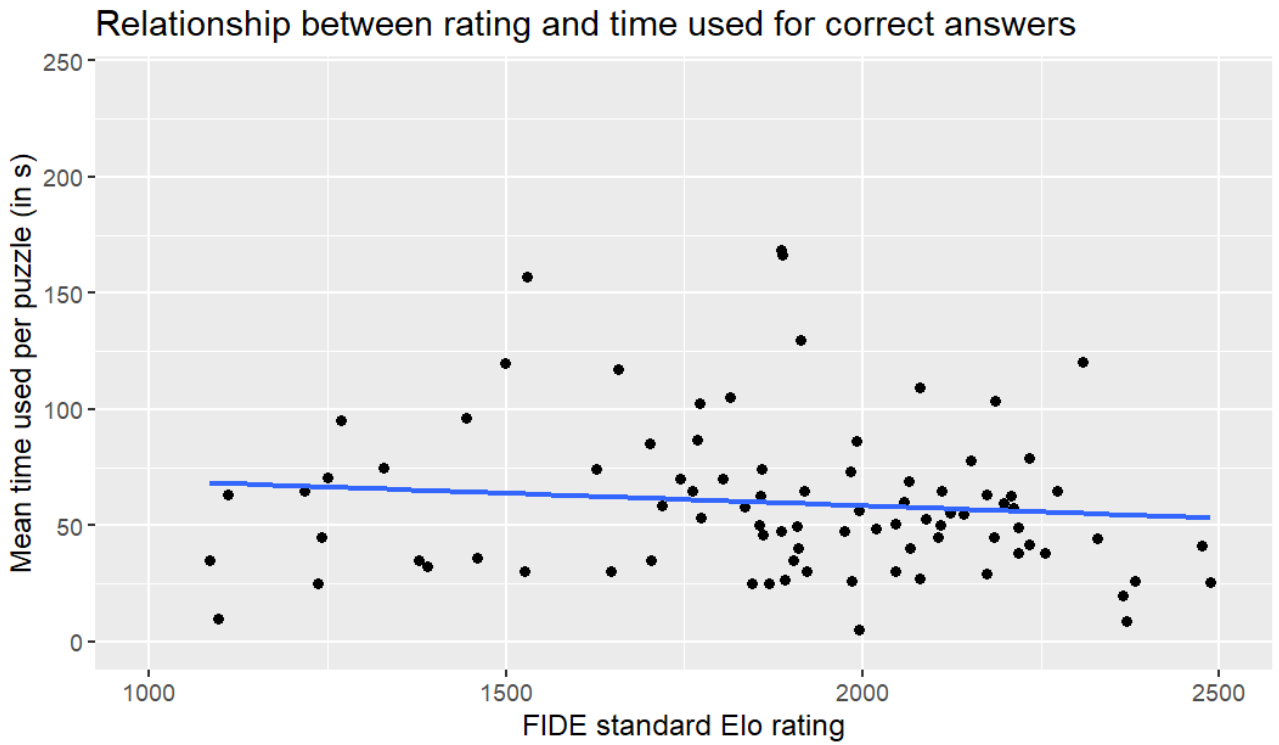


Figure 10: Relationship between FIDE standard Elo rating and mean time used per correct answer in the experimental group.

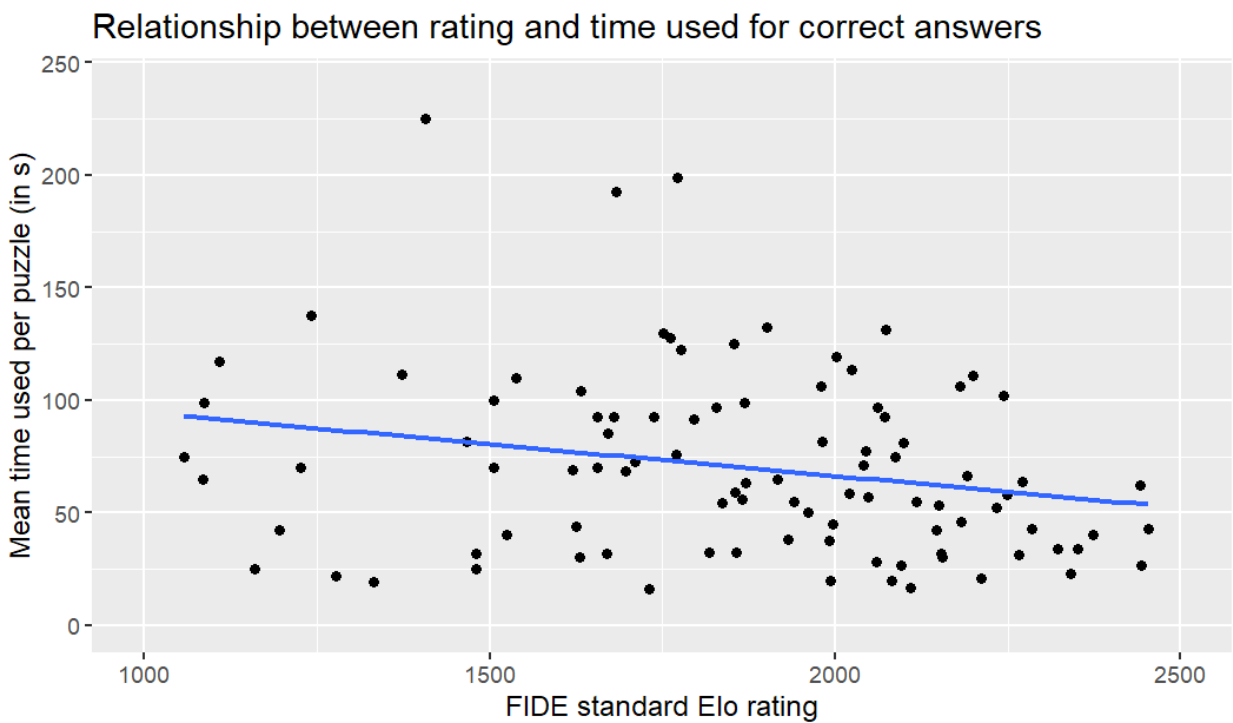


Figure 11: Relationship between FIDE standard Elo rating and mean time used per correct answer in the control group.

3 Test scores

Hypothesis: Chess players make better decisions if prompted to consider candidate moves, compared with players who are just asked to find the best move.

3.1 Distribution

Overall distribution is visible in Figure 12. The histogram shows that there are only four participants that solved all puzzles correctly, which indicates that there was no ceiling effect. Interestingly, there were 22 participants who solved all puzzles incorrectly. This suggests that the puzzles might have been too difficult. However, a one-tailed unpaired t -test indicated that participants who solved all puzzles incorrectly used significantly less time compared to participants who solved at least 1 puzzle correctly ($M_{\text{correct}=0} = 43.3s$, $M_{\text{correct}>0} = 71.1s$; $t(27.169) = -3.188$, $p = 0.002$). The distribution of puzzle scores of the individual conditions is visible in Figure 13 and Figure 14.



Figure 12: Distribution of the number of correctly solved puzzles across both conditions.



Figure 13: Distribution of the number of correctly solved puzzles in the experimental group.

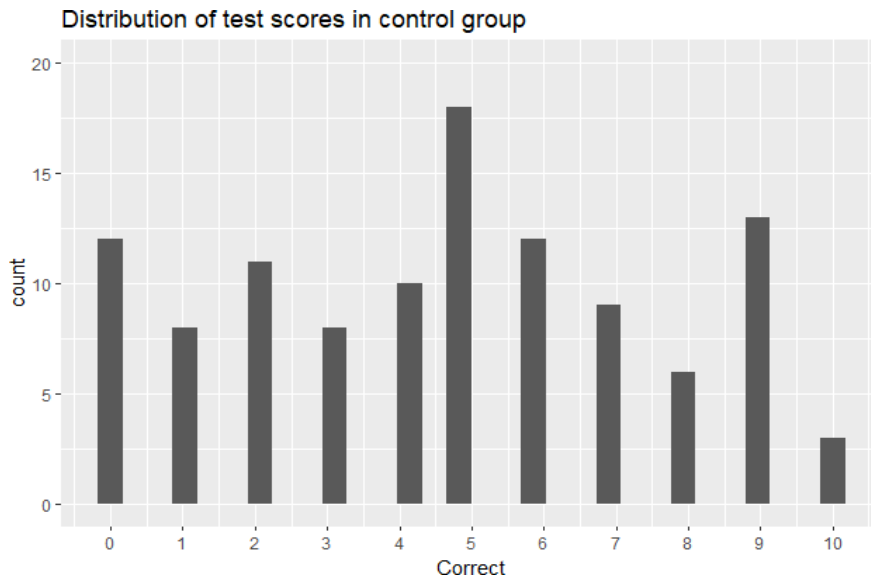


Figure 14: Distribution of the number of correctly solved puzzles in the control group.

3.2 Mean scores

Mean score for experimental: 4.54, mean score for control: 4.67. See Figure 15 for means and standard error. We failed to find statistical evidence that the experimental group scored better than the control group.

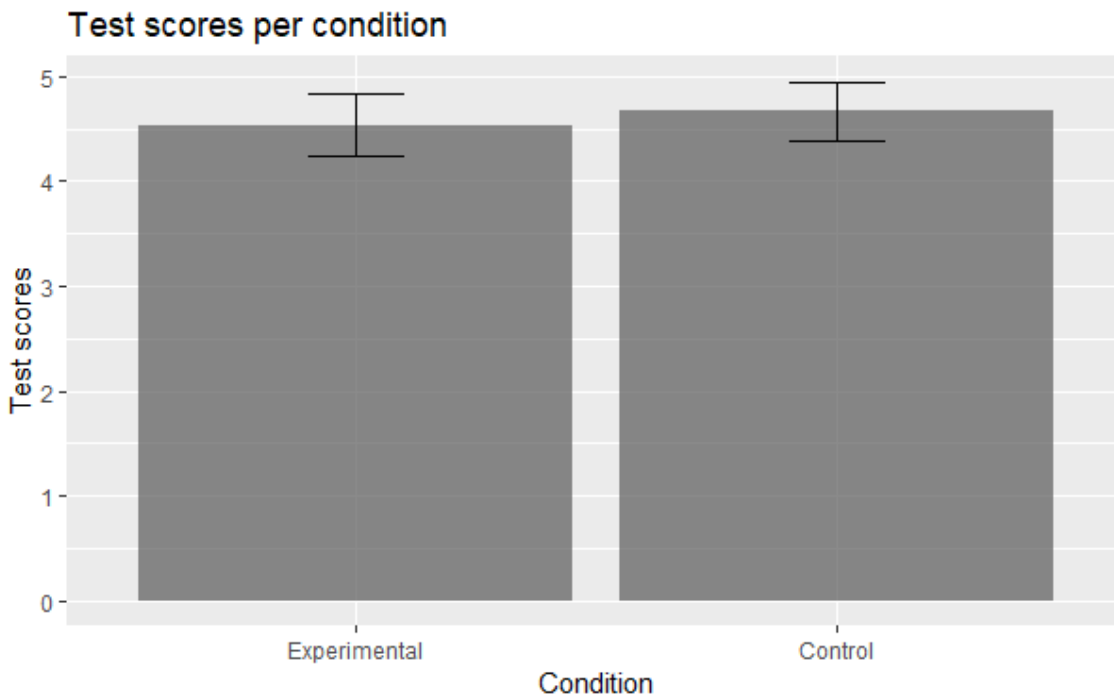


Figure 15: Mean test scores of participants per condition. Error bars denote ± 1 SE.

Data analysis with mixed-effects logistic model

We analyzed the data using a mixed-effects logistic regression implemented in JASP (version 0.16.4). Our dependent variable was puzzle accuracy, which was scored as either correct or incorrect. We added fixed effects of FIDE rating (described using 5 bins: 800-1199, 1200-1599, 1600-1999, 2000-2399, 2400+) and instruction type (Candidate move method vs. Control). We also included Participant ID and Puzzle ID as random effects. To facilitate model convergence, our random effects structure only included the estimation of intercepts for Participant ID and Puzzle ID from the data. The contribution of each fixed effect was examined using likelihood ratio tests, which indicated that only the binned FIDE score was a significant predictor of puzzle accuracy (Chi-Squared = 92.162, $df=4$, $p<0.001$). In Figure 16, we plot puzzle accuracy as a function of binned FIDE score for both the

Candidate move group and the Control group (error bars are 95% confidence intervals of the mean). This illustrates our main result, which is that players with a higher FIDE rating were more accurate than players with lower ratings.

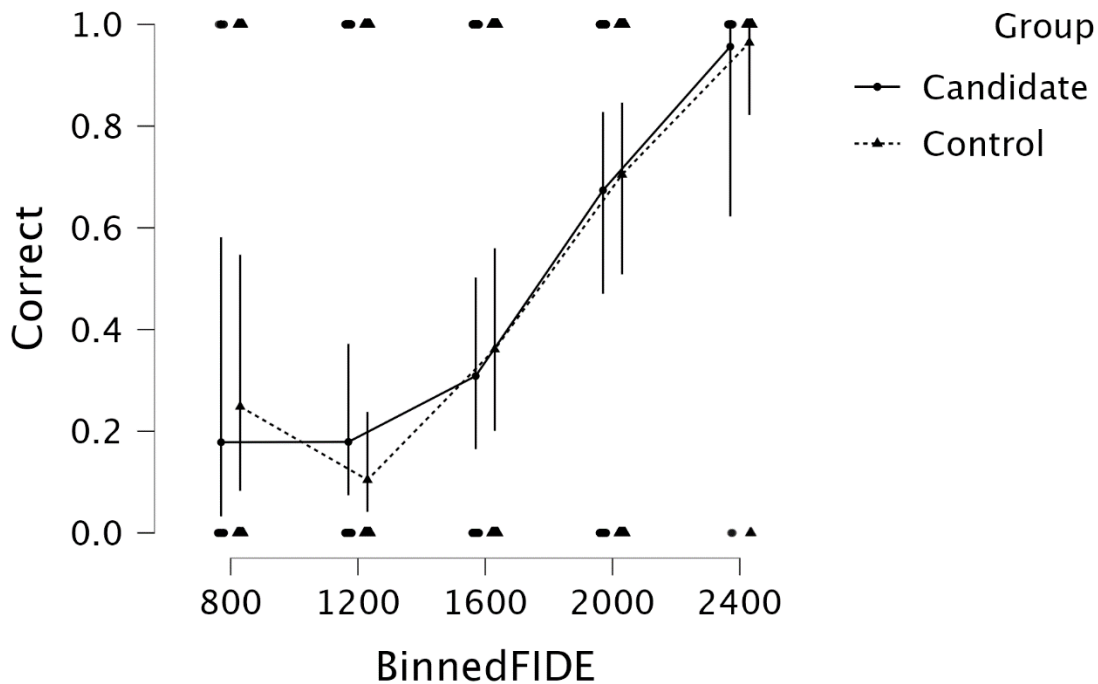


Figure 16: Puzzle accuracy as a function of binned FIDE standard Elo rating.

3.3 Subgroups

rating range	experimental	control
<1550	20	26
1550 – 1850	20	27
1850 – 2100	31	30
>2100	26	27

Table 4: Split of participants into subgroups based on FIDE standard Elo rating.

The splits were based on the criterion that each subgroup should contain at least 20 participants.

For the subgroup < 1550, a one-tailed t -test did not find that the experimental group scored better than the control group ($M_{\text{experimental}} = 2.70$, $M_{\text{control}} = 2.35$; $t(38.046) = 0.503$, $p = 0.31$).

For the subgroup 1550 – 1850, a one-tailed t -test did not find that the experimental group scored better than the control group ($M_{\text{experimental}} = 2.95$, $M_{\text{control}} = 3.48$; $t(34.574) = -0.722$, $p = 0.76$).

For the subgroup 1850 – 2100, a one-tailed t -test did not find that the experimental group scored better than the control group ($M_{\text{experimental}} = 4.74$, $M_{\text{control}} = 5.30$; $t(58.983) = -0.893$, $p = 0.81$).

For the subgroup > 2100, a one-tailed t -test did not find that the experimental group scored better than the control group ($M_{\text{experimental}} = 6.92$, $M_{\text{control}} = 7.41$; $t(47.828) = -0.841$, $p = 0.80$).

Puzzle scores

Puzzles 6 and 8 are about backward attacks. (Puzzle 6: 1...Qh8, puzzle 8: 1.Ne1.)

group	puzzle 6 (in %)	puzzle 8 (in %)
experimental	45.4	28.9
control	40.9	45.5

Table 5: Success rate on puzzles containing a backwards move.

These tables do not indicate that the experimental group performed better than the control group on the backwards moves puzzles.

To compare the proportion of individuals in each group that solved these two puzzles correctly, we carried out a z-score test of population proportions. For Puzzle 6, this analysis yielded a z-score of ~ 0.65 and a corresponding p-value of 0.52, which does not allow us to reject the null hypothesis that the two groups did not differ in their success rates. For Puzzle 8, the same analysis yielded a z-score of -2.46 and a corresponding p-value of 0.0139. This does support rejecting the null hypothesis and suggests that the Control group performed better than the Experimental group on this puzzle. Even if we correct these p-values for multiple comparisons (effectively halving our critical value of p to 0.025) this result stands.

Conclusions and Discussion

Conclusions

We did not find evidence that chess players make better decisions if prompted to consider candidate moves, compared with players who are just asked to find the best move. While participants' ratings did correlate with more accurate puzzle solving in both groups, our results showed only a non-significant trend in the opposite direction, with slightly superior performance from players in our control condition. The candidate move method thus did not systematically improve puzzle solving performance in this task relative to a broader instruction to determine the best possible move.

Discussion

There are a number of reasons why we may have failed to observe the predicted effect in this study. One potential limitation of our design has to do with the nature of our control group: In the control group we cannot rule out the possibility that participants know about candidate moves and used this method to some degree. In this case, our two participant groups may have been effectively doing the same thing to solve these puzzles, leading to no significant results between the two conditions. Even if our control participants weren't explicitly using the candidate move method, the fact that we don't have a means of determining exactly what processes they were using to solve these puzzles complicates our interpretation of the data.

Besides this concern about the nature of the control group and their approach to these puzzles, there may also be features of how the candidate move method was applied in our experimental group that we did not account for.

A possibility suggested by Fernand Gobet (from a personal communication between Gobet and Can Kabadayi) is that people in the candidate move group may get distracted by having to choose several options as it may interfere with their normal habits of finding a good move. Receiving such a prompt at the beginning of the puzzle may have confused the participants. To address this concern, Gobet suggested implementing a third (placebo) group, where the participants will be given a prompt to only focus on one move instead of generating three candidate moves (the opposite of our main condition). This approach would help mitigate the possibility that the initial prompts themselves could adversely impact the performance of the candidate move group.

Having to think about three possible moves (as we instructed participants to do) might slow down participants' thinking or otherwise complicate their analysis of the positions. However, we see in our data that participants in the experimental condition on average tended to use less time than participants in the control group. This raises an additional concern that participants in the candidate move group may not have been applying the method as we intended, making our two participant groups more similar in their approach to the puzzles. Even if we assume our participants in the experimental group were indeed using the method, unfamiliarity with the approach could still complicate our results. Though the use of candidate moves may be beneficial if one has some training in how to apply it, it is possible that any participants in our experimental group who had not used this method before found it cumbersome, weakening their performance. GM Artur Yusupov says the concept of candidate moves is difficult to use, which offers some support for this perspective. He notes that a key step in the method is to find good candidate moves, which in itself is a complex process that depends on many factors. Hurtado found strong players are much faster than weak players in pattern recognition, for example, but they take more time in evaluation before making a decision. Considered together, these observations lead us to wonder if explaining in just a few sentences what the candidate move method is may not have been sufficient to improve performance in our task. Perhaps more direct training with the method would lead to better test scores, though this would need to be compared to a different training method so that a fair comparison could be made. Alternatively, one way to modify our candidate move instructions could be to ask participants to first offer three candidate moves that they are considering prior to submitting a solution to the puzzle. In this way, we could both confirm that participants are indeed identifying multiple possibilities to analyse and strengthen their understanding of what the candidate move method entails.

Though we did not observe the predicted result in our data, we think that these data still raise some interesting questions for future research. Besides addressing some of the concerns we expressed above, there are other possible points to consider in investigating how players of varying strength identify solutions to chess puzzles. In our design, for example, two of the solutions required a backwards attack, which may be more difficult for participants to see as a useful possibility due to cognitive biases. Players may tend to associate attacking with forward movement, making backwards movements that offer attacking possibilities more challenging to notice. Our own study is not sufficiently powered to compare performance across these specific puzzle types meaningfully, but future work to investigate how different tactical themes may benefit from different puzzle solving approaches may yield new insights. The role of confirmation bias in puzzle solving and chess praxis more generally has also been studied by a few researchers, but has still not been widely examined as a factor affecting decision making in players of varying strength. Overall, there is still a great deal of room to investigate how players determine the best possible move in different positions and how different approaches to analysis may lead to better or worse outcomes.

ANSWERS ON OPEN QUESTIONS IN CHESSQUIZ

In general the answers were very short like yes and no.

- By Karel van Delft

Experimental condition (68 participants, one blank, so 67). Asked to use candidate moves method.

Question 1. Did you know the candidate moves method before?

50 answered 'yes'

Sometimes with an addition like:

Yes, in Kotov's books

It is a method by which several possible and reasonable plays are thought of and taken as a starting point to deepen the analysis.

Yes, I am aware of it, but it didn't seem very useful in most of the problems, because it seemed to me there was only 1 or 2 good options. Mostly just 1 option.

17 answered no.

Question 2. How useful do you think it is?

47 Answered very useful, or a similar description.

Some added it structures very well their thinking.

Some said there can be a limited usability, for example only in tactical positions.

Others mention it is not always useful, depends on the kind of position.

One respondent says:

I think it's useful, perhaps most for the advancing player who has to learn how to calculate. A more experienced player also might trust other things like pattern recognition and his intuition.

12 don't think it is useful.

8 others had vague reactions.

Question 3. Do you use other methods for your search strategy and if so which?

Here we show all answers given. Only a few typo's are corrected.

Looking for forced moves first, then captures and threats

No. Only this one

No, most of the time the moves come naturally to me.

Loose pieces, killer common squares

pattern recognition and memory

Not really

Aimchess

?

No

yes. check first, all checks, then captures, and then forced moves

No

I use heuristics more than algorithms. E.g. asking questions like "What is my opponent's plan?",

"What is my worst piece?"

Look for checks, capsules and pieces that can be attacked

Yeah, I use the method of disappearing piece (especially the one that stops my threats I feel the most dangerous)

Captures/checks/threats; Improve worst piece; Always include a positional move.

If there's nothing tactical/dynamic happening in a position, I look for my opponent's plans and try to prevent them, or find my worst placed piece and try to improve it

no

Iosif Dorfman Method, 3 Questions Aagaard

First I look what seems best accordons to plan

Not very consciously

Looking for forcing moves

Not that I'm aware. I guess trying to feel when it's a critical position

elimination, comparison and prophylaxis

No specific methods

No

Scat

No specific method. Just random looking

follow a plan

I can't give a name for the used method

I haven't thought about my search strategy in a formal way, but I guess it basically boils down to identifying candidate moves.

no

Usually looking for more good options like here

yes, depends on the position. Sometimes I first dwell into a move and only then do I search for other candidates

King safety, loose pieces, inactive pieces, clearly winning combinations, sound moves.
Check, capture, threads
combination of intuition, random thought and key moves
Look at forcing moves
forcing moves like check, killing and attacking
no
Forcing moves and imbalance position
I prefer a mix of intuition + the checks captures attacks method
Yes, sometimes I'm searching for patterns and then looking for moves fitting the pattern.
Checking the following: king safety, weak points, unprotected pieces, typical tactical motifs like pinning, skewers etc.
looking for weak points, checking possible "routes" or squares for pieces
I use Buhmanns 4x4-method (which is a kind of candidate moves)
In non-tactical positions i trust my intuition
Mostly rely on intuition
globally scanning the position for weaknesses
no
No
Not a method (and maybe that's the problem) but just look at good moves.
I always check for king safety, unprotected pieces and knight moves ...
Looking for a good move. If something looks good, check if it works :)
I use mostly the method of "Checks, takens and warnings"
Dorfman's Method
decisions tree
long term ideas
When im looking at a position without the initial moves i search for tactics and once im satisfied there aren't any tactical possibilities, I look for ideas and select according to which ideas I feel are important.
I don't think so, but sometimes intuition is used.
checks, captures and threats
check, take, attack
looking at opponent's threats, examining captures/checks/threats, asking what worst placed piece is, blunder checking blunder checking
Forcing moves first, then ID any ways the forcing moves go wrong, then forcing moves addressing those problems. It's similar.
Just raw calculating starting with most natural moves
Look for opponents weak pieces.

Question 4. Do you want to add anything to this?

Here we give all reactions, other than 'no'?

Looking for opponents ideas
I liked the book (Move First, Think Later) of Willy Hendriks a lot :-)
It was a nice test, glad to be of service and looking forward to the results of the survey!
Good luck with the study!
I believe the method of removing a piece (mostly the opponent's but it can be ours too) can be a way more powerful than candidate moves
Nice examples!
I already knew two of the positions. Many of them the correct answer was the first move I considered (it was my only candidate and obviously winning), so I'd just fill in some random stuff for the other two candidates.
I wasn't as concentrated as I would have liked
I feel bad that in one or two of those positions, I saw the correct move just after submitting another [reasonable] move. Maybe too much online blitz has made me choose moves too quickly. (I have to remember: when you see a good move, wait and look for a better one.)

maybe see some statistics of the chosen moves directly after the 3 candidate moves
Candidate moves are useful in positional positions where there is not really one best move but several good ones.
Good luck with the research!!
The exercises varied greatly.

Control condition (74 participants, one blank, so 73) just asked to play the best move.

Question 1. Can you tell us what kind of search strategy you use when you solve this type of puzzles?
We give here all the complete reactions.

First looking for a theme, and then trying to make it work.

Forcing moves

Chess books and magazines

Intuition

I did not really have to use an active strategy. I recognized the critical patterns quite quickly and tried to calculate a few lines to make it work.

Start with finding out what's going on: which pieces are hanging, pinned, have no squares etc; king safety etc. If the solution doesn't follow immediately from this first glance, look for candidate moves that make use of the observed features of the position and calculate them as far as possible. First calculate the most forcing lines.

1. Evaluation (piececount, treats, king safety, structure). 2. Looked for trapped pieces. 3. calculated check, capture etc.

look for threats and how you can prevent the opponent defending them

Forcing moves first (checks, checkmate threats, captures, capture threats; in that order). When I can't find by force I look for signs (trapped piece, undefended piece, etc), although in most puzzles these signs/threats were clear from start. Checkmate threats are usually the toughest to spot but I'm experienced with such puzzles, I think I found 2 in these (Qh8 in one, Bf8 in another). When mutual hanging stuff and forced lines don't work I also look for desperados, like in the last puzzle (Ba6).

Material, opponents threats, position I would like to get

look for checks and combinations

i can't, no conscious "search strategy"

Look for checks, mates, takes (both sides). Then combinations to create forks, mates or other attacks.

Thinking

I tried to calculate forcing moves and find the key idea in the position

Looking for direct mate, if not in sight look for 'loose / uncovered ' pieces

Calculating and remembering patterns

Forcing moves

checks captures and threats

Looking for a win/decisive advantage

I look for hanging pieces or inadequately defended pieces.

Mostly intuition to find the first move. Then I calculate to see if my idea works. If it doesn't I look for problems in the position and how I might be able to solve them.

Forcing moves first, CCTV

Find forced variations, recognise motives

It's hard to formulate. The search process is rather random and intuitive.

Ruchy kandydat

I searched for undefended pieces, patterns like forks, back rank pieces,... also pieces that could be trapped

Intuition and double checking

I'm looking for tactical solutions and avoiding too easy solutions (verleidingen)

Look for checks, forcing moves and loose pieces

I first look for as many different candidates as possible and then start calculate the most promising candidate and so on. When I don't have a clear solution I try to combine lines or use different mover orders.

Forced moves, patterns, deduction

I look for gaining material or mate if the position suggests a possibility

I follow forced moves calculation

Themes, trial and error

I first check the moves my intuition tells me, then I try to make it work and if it doesn't, move onwards to less intuitive moves

Normal

Try to find the weaknesses of the enemy position, and find ways to make use of them

Threats, checkmate patterns

Normally I just analyse and solve it myself, I use Lichess.

Look for checks, captures, attacks first. Then look for the weakest pieces in the enemy position and how to target them. Trying to calculate short lines quickly.

Checks, captures and threats. Forcing Chess Moves. Re-ordering the moves

Candidate moves (Checks, captures, threats), calculating moves, checking move order

Search for the forcing moves

I don't use any structured search.

Mate in 4

I analyze with a method that consists in seeing the 4 forced moves in chess to answer every position in chess: captures, checks, threats of checkmates and threats to pieces. as well in my calc I use the elimination and comparison method.

Start by looking for forcing continuations. If I find something, look for any counterplay and look for ways to interact with that idea. If non available, evaluate starting position and calculate captures, then try to evaluate if resulting position is better or worse.

I look at possible weaknesses (loose pieces, pawns, the enemy king position, etc.) And then try to calculate a couple of moves ahead to see if something comes up that makes use of the weaknesses

I calculate through the position

I try to judge the position. Strengths and weaknesses

Hanging pieces, harmony, king position, endgame transposition

Tactics

I try to imagine it is one of my games, so I can somehow find enough motivation.

1. See what patterns jump out (though I am quite rusty as I haven't played for several years). In this set of puzzles there seemed to be pieces that were short of safe squares to go to, some pins and also some lines of defense that could be interfered with. 2. Look at forcing moves - checks, captures, attacking pieces, moving my attacked piece so that it can no longer be exchanged for my opponent's attacked piece.

I start thinking the obvious ones, then checks and then I look for moves, where can I capture a piece

I look for undefended (or not sufficiently defended) pieces.

Check, Capturing, Attacking

It's hard to explain. I was instantly attending to the tactical feature in the position. Then, I was trying to make it work by calculating possible alternatives and comparing the final evaluation to how good I think the position can get. When I felt I found the best move, I did it.

I don't know. The answer just pops up in my head or it does not. Probably Checks, captures and threats :)

Checks, Captures, Threats and Sacrifices

I look for unexpected tactical opportunities

I usually have an intuitive idea of what the key idea is supposed to be and then try to work out the variations from there

Check, takes, and threats

Intuition, candidate moves

looking for candidates, and then calculating each one

Search for loose pieces. Calculate checks captures and threats

looking for a weakness and then how to exploit the weakness (extra attack or in between move or something like that)

Undefended pieces / weak king

First threats, checks and captures, followed by searching for tactics, and finally strategic considerations.

Just thinking

No particular strategy as such; just analysing until I think I have the answer.

Question 2. Do you want to add anything to this?

Here we give all relevant responses.

The puzzles are too hard for me (1400 elo) :)

Silent moves

indicating time left was not seen immediately and could be better

I am interested in knowing how can puzzles be a method of studying decision making

I would like to know the answers to my incorrect solutions!! ;)

I liked the quiz but maybe next time you should give more time and give puzzles based on rating

It would be amazing to include eye-tracking

It went bad, don't know why

I will be interested to see what I missed.

With the first mistake, I felt like I am missing something because I evaluated the final position following my variation as maybe better but not too much. But I couldn't find the win, so I went for it.

It was fun solving. Pity, I got one wrong.

it was easy problems



IM Mark Dvoretzky in Apeldoorn with Thomas Beerdsen (right) and Armen Hachijan. (photo Karel van Delft 2010)

www.youtube.com/watch?v=GxNv6Mix2kg and www.youtube.com/watch?v=cl3eNk42wTU&feature=related

INTERVIEW GM LIAM VROLIJK AND GM THOMAS BEERDSEN

- By Karel van Delft

GM Liam Vrolijk and GM Thomas Beerdsen: It is more looking very concretely for moves

What do younger grandmasters think about the method of using candidate moves? Did they read about it, do they have outspoken ideas? What are their experiences? Are there differences in thinking during training and playing between generations? What role does the computer play in these issues?

This interview with GM Liam Vrolijk (21, Elo 2562) and GM Thomas Beerdsen (25, Elo 2501) was made February 29, 2024 via Zoom. Both players know each other well. In the season 2022-2023 they were both top scorers with 8/9 in the Meesterklasse, the highest Dutch competition league for club teams.

During games he uses the method of candidate moves probably not enough, Beerdsen says. 'Wasn't it Kotov who started with it?' He doesn't use this method for sure not very conscious. While playing he considers several options, but not very structured. 'In my case it is more looking very concretely for moves.' Vrolijk says this method of considering several moves he knows mainly from training. 'More than using it in real games. But maybe in games I use it subconsciously. I don't think about it during a game.'

How would they define candidate moves? Beerdsen: 'Maybe possible moves in a position or something like that?' Vrolijk: 'Serious possibilities I think.'

Kotov said players should approach chess more scientifically, and improve their chess on the basis of gaining insights. His method of candidate moves and the tree of analysis, however, was criticized and improved by later authors like Dvoretsky and Nunn. Also not all positions can be analysed with the method of candidate moves. Using the method systematically on each move seems not practical, Vrolijk says. Beerdsen agrees. When there is a critical position you feel it, Vrolijk says. In that case you start to consider more systematically several options. Again, Beerdsen agrees.

Did they ever read anything about the method of candidate moves? Both didn't. Vrolijk even hadn't heard about Kotov before.

Vrolijk and Beerdsen both recognize candidate moves as a method some of their trainers used. 'Sometimes you cannot solve a position during a training and then trainers show this tendency of asking you questions about what the candidate moves might be, to help you a bit further', Vrolijk says. He gives grandmasters Ivan Sokolov and Mikhail Gurevich as examples. Beerdsen says he remembers vaguely that during training in his birth town Apeldoorn IM Mark Dvoretsky used these ideas.

Do Vrolijk and Beerdsen see differences in thinking between generations of grandmasters? Elder grandmasters say younger grandmasters think much more concretely. Vrolijk and Beerdsen say they do agree with that. 'For me personally it is even worse', Beerdsen says. 'I am not very good at conceptual thinking. I am always busy with very concrete calculations. Liam is better in making plans, normal chess let's say. But even he thinks much concreter than all those elder grandmasters.'

It has to do with computers, Vrolijk states. 'But also because of the Dutch Steps method, which is very popular in the Netherlands. We are educated very tactically. The Dutch players are tactically much stronger than players from most other countries. If you are tactically strong, it follows that you become more concrete in your thinking.' But it also has to do with the computers, Beerdsen adds. 'When you see what you can get away with because the engine is okay with it... Elder grandmasters wouldn't play certain moves, because they don't look like anything. But if a move works, it works.' Nowadays one must remember much more than in former times, Vrolijk sees.

Which brings the discussion to Bloom's Taxonomy which consists of six thinking levels. The lowest level is remembering and the highest level is creativity. This concrete trend plays a greater role in the opening, Beerdsen says. There you can get in big trouble without concrete knowledge. In the middle game you have more chances with conceptual thinking.

Besides the style of players is also of influence the two young grandmasters think. They say that older grandmasters with a more tactical style have hard times when chess gets more concrete. Also for

them physical and maybe motivational aspects count.

These differences between generations of grandmasters is never a topic of conversation. Both young grandmasters of course speak regularly with elder grandmasters, but it is always about analysing games. Never about ways of thinking or training methods.

The conversation shifted to several solving methods and research done by the Chessable science team about reversed solving, which is backwards reasoning from a position you want to reach to the current position. This is opposite from forward solving, where you look at how to go forward from the current position.

The method is nicely described by IM Thomas Willemze: You start with a target position, and reason backwards. For example: 1. activity on 7th rank, 2. enter 7th rank via open line, 3. occupy open line, 4. create an open line.

Vrolijk and Beerdsen have never on a conceptual level thought about the method, but when talking about it they recognize the idea and conclude sometimes they use it.

In the candidate moves literature up to now reversed solving nowhere seems to be discussed as a potential technique to look for the best move. It could be, Beerdsen says, nobody formulated it clearly as a concept in a candidate moves context. If so, players can use it in their daily practice, but don't have theories about it.

So, who knows what this can bring. Although criticized for his rigidity, Kotov had a point that one can profit from scientific research on chess thinking if that research can be transferred to better training methods.

Problems and studies are rich in candidate moves by GM of chess composition Yochanan Afek (text) and GM Sipke Ernst (text in analysis)

Candidate moves and chess composition: It has been established by the world's best chess trainers that solving endgame studies and mate problems are instrumental in improving tactical and calculating skills, creativity and out-of-the-box thinking in general and spotting candidate moves in particular.

While providing the player with a whole range of attacking and defensive weaponry and deepening their endgame understanding, studies demonstrate by a small number of pieces the full power of a single piece alone and in interaction with other pieces.

The beauty of the endgame study has the power to intensify chess passion and the joy of playing. The process of solving an endgame study is similar to that of selecting the next move in an over the board game, because problems and studies are rich in tries (candidate moves). No wonder leading trainers such as IM Mark Dvoretsky, national Indian trainer GM R. B. Ramesh, GM Jacob Aagaard and many others regularly use solving studies as an important part of their training program.

I recommend to my pupils: One study a day keeps blunders away!



Jozef Moravec 1925

[Gameviewer study Jozef Moravec 1925](#)

I think this study is an excellent example for the use of the comparison method. It is white to play. White is a pawn up but a quick scan makes it clear that white is fighting for a draw. Where to start? Intuitively one would try to calculate Kf5 first and see if that works. **1.Kd5!** This counterintuitive move draws. This move achieves exactly the same as Ke5 without standing on the a1–h8 diagonal so white avoids the skewer that happens at the end of the line with the king placed on e5. [Candidate moves: 1.Ke5? Kg2 2.h4 Kxf2 3.h5 Kg2 4.h6 f2 5.h7 f1(Q) 6.h8(Q) Qa1+→ turns out that Ke5 was not so successful. So what remains to try is Kd5; 1.Kf5? it is to me the most logical move to try first because all the action takes place on the kingside. Who knows the king can support the h-pawn this way? 1...Kg2 2.h4 the only try. The line is forced until the end. 2...Kxf2 3.h5 Kg2 4.h6 f2 5.h7 f1(Q)+→ is easy to calculate. White is lost. Back to the drawing table. Are there any alternatives? We can consider Ke5, or maybe Kd5?! Let's see if there is a difference between any of the two moves. I would first try Ke5 (but maybe you would try Kd5 first?). We are going to compare both moves (=comparison method) and check what happens...] **1...Kg2** [1...Kxh2 2.Ke4 Kg2 3.Ke3+–] **2.h4** [Candidate move: 2.Ke4? Kxf2 3.h4 Ke2→ white's h-pawn is too slow.] **2...Kxf2 3.h5 Kg2 4.h6 f2 5.h7 f1(Q) 6.h8(Q) ½–½**

CONCLUSIONS

Candidate moves are the moves that deserve attention in a given chess position. Choosing candidate moves is multifaceted. It is about a concept as well as methods. A concept is an abstract idea, a fundamental building block underlying principles, thoughts, and beliefs. A method is a particular procedure for accomplishing or approaching a goal.

Multifaceted means it is about using the right methods and techniques in the right situation. Pattern recognition plays a crucial role in recognizing possibilities and limitations while evaluating positions.

Expert interview

To find answers we had an expert interview with GM Artur Yusupov, checked literature by chess authors, looked for scientific insights, tested a hypothesis via an online test, wrote about the use of studies for training and interviewed two young grandmasters about changes in chess thinking influenced by use of computers.

GM Artur Yusupov states the theme of candidate moves is extremely important for chess players. In trainings for beginners and young chess players the concept that is not obvious at all.

A pitfall for many chess players is they think that they see the best move in a position immediately and don't look for alternatives. Yusupov considers candidate moves not only as a concept, it should be used as a method, a way of thinking in which you use several techniques. Important is to check several possible continuations and compare evaluations. Then, coming back to the original position is extremely important. It could mean you have to search for more alternatives.

The concept of candidate moves involves aspects of searching strategies and decision making.

Research about candidate moves is useful, Yusupov states. 'It could lead to methodological advice for training.'

In training pattern recognition and tactics play an important role, Yusupov states. But also synthetic qualities and bringing ideas together. An important aspect is to consider also the possibilities of the opponent. Asking all the time for alternatives is essential.

What chess authors say

It is clear the concept and method of candidate moves is multifaceted and developed over time.

Since GM Alexander Kotov presented his ideas about the selection of candidate moves and the 'Tree of analysis' in the book 'Think like a grandmaster', many authors and trainers used the idea of candidate moves. Also Kotov was criticized and new insights came up.

There are differences between grandmasters, Kotov says. Some rely more on sober analysis, others use more intuition. Making plans is based on features of positions, but also the character of players is of influence.

Economy of thinking time is important. Kotov advises the Blumenfeld Rule: after long analysis look at

a position through the eyes of a patzer, is there a mate or a capture possible?

Kotov advised to go through a variation only once, which was criticized for its rigidity by many authors later. They state that often a new idea will not be found in the initial position but at the end of a series of moves, which can lead to a new candidate variation.

Later authors discussed many aspects of candidate moves. Since there is overlap, we don't repeat all authors here. The authors gave all kinds of advice, such as:

Michal Krasenkow: Define the aim of your analysis, look for ideas to achieve the aim, analyse variations in order of priority, train calculation and imagination. Start with the simplest variations.

Mark Dvoretsky: clarify your aims, try to neutralize your opponent (prophylaxes), there are no recipes suited to all cases, first examine most forcing line, move order is important, combinative vision is necessary, use techniques as the emergency exit, elimination, comparison, develop principles of your own.

John Nunn: With only five realistic possibilities on each turn this would lead to 15,625 'leaves' after three moves. Best is a quick scan of several possibilities. Then you can eliminate quite fast non-promising variations and concentrate on more promising lines of thought. Sometimes you find in one variation an idea which you can apply in another variation. That is why it sometimes is good to jump from one variation to another. The tree of analysis is useful in tactical positions, but in more strategic positions other types of chess thinking are necessary, such as the 'goal setting' approach.

Johan Hellsten: As a human player, one has to be practical.

Amatzia Avni: Research has indicated that experts are able to recognize meaningful patterns of information unnoticed by novices. They organize their knowledge around core concepts and major principles that guide their thinking. Experts are also capable of flexibly retrieving important aspects of their knowledge with little attentive effort. A great deal of an expert's knowledge is tacit, they can't always articulate their thinking process.

The unconsciousness plays a role. Many bright ideas descend upon a player when his mind is floating. They go for a walk, get involved in another activity, and then sometimes a solution suggests itself.

Andrew Soltis: Chess players think in generalities (patterns, rules of thumb) but calculate variations. Calculation is a skill that can be studied, learned and sharpened. If we ask simple questions, we sometimes break down complex problems into their elements. Visualization is essential, it is the power to consider positions that have yet to occur and to recognize the possibilities in those positions. Don't assume there is only one application of an idea. There might be several ideas at work in a position. Sometimes you can combine them. Rules and maxims should not be used as a substitute for thinking. But they are wonderful as prompters to thinking. Knowing when to calculate is just as important as knowing how to calculate.

Willy Hendriks: There is no order in the way we look at the board. Improving in chess does not depend on implementing a few smart thinking methods, but mainly on building up a large amount of high quality chess knowledge. It is all about good moves. Hendriks states clearly he thinks you can learn chess only by working with concrete positions. For example via solving exercises. 'There is no order at all. We don't first judge the position and then look at moves. It all happens at the same time.' It is strange we talk about 'seeing' combinations and 'making' plans, Hendriks says. He thinks making is often a matter of seeing. For that reason he states you should not learn to make plans, but instead should learn a lot of plans which you can use in games.

Merijn van Delft: Expert players are unconsciously skilled, much insights go automatically. Less strong players are consciously skilled, which means they profit more from verbal explanation and reasoning. He states Hendriks clearly focuses on the thinking of experts. The difference between the different development phases is relevant on many points, for example when it comes to rules of thumb.

Michael Adams and Philippe Hurtado: Strong players base their analysis mostly on concrete calculation rather than general principles, while weaker players are 'hand waving' much more, by justifying their move with general concepts and rules of thumb rather than concrete lines. Strong players, using their expertise and large number of chess chunks, incredibly quickly reduce the possible candidate moves to 1 or 2 possible moves and quickly eliminate analyzing the weak alternatives. On the other hand, weaker players are distracted by more options on the very first move that may all look fine. This leads to a loss of time and inefficient calculation.

Josh Friedel: As a trainer look through the eyes of a beginner.

Stefan Kindermann and Robert K. von Weizacker: Backwards (reversed) thinking is a powerful tool when choosing the best move. It means analysing a chess position starting with an end position in mind.

Science and psychology

Although science and in particular psychology have a lot to offer for chess training and playing, there is no specific scientific research done about candidate moves and chess.

There are many applications of psychology possible to chess. Psychology can offer insights in information processing and self-management.

How to apply scientific knowledge to practice? Reflect on insights and experiences with a growth mind-set. Develop thinking and behaviour routines.

Chabris says Kotov is a pioneer in the chess literature by researching thinking processes of chess players rather than analysing chess technical issues. Insight in their thinking gives players more grip on their development and performance in games.

Chabris agrees with Dvoretzky about three reasons why candidate moves are useful: 1. It helps surveying variations rationally and structures your thoughts, 2. Helps with time-management and 3. Discovering resources you didn't suspect at the outset (an idea found in one variation might fit well in another variation).

Chabris mentions that it is almost always overdone when people appeal to neuroscience to explain how you should study chess, which functions are involved etcetera. You should look at what works, unless there is very solid evidence for such claims.

Important while learning, he says, is asking the Why-question. If you understand you remember better and can use the theme in similar situations.

Do GMs see the board differently?

Vision science and cognitive science can contribute insights to understanding perception and information processing of chess players, Ben Balas states.

He gives an overview of scientific research starting with Adriaan de Groot and his book 'Thought and Choice in Chess', which made clear pattern recognition plays a crucial role.

Research suggests that stronger players perceive chess positions in terms of a visual summary that differs from that of weaker players. Whether you're a chess expert or not, you use visual summaries like this too when you look at complicated scenes, but chess expertise leads to a specialized visual vocabulary for summarizing board configurations. That vocabulary, which appears to involve neural mechanisms for perceiving patterns at a large spatial scale as well as access to positions stored in long-term memory, supports better recall for chess positions, differential deployment of visual attention over the chessboard, and better discrimination between subtly different chess positions.

The question remains however whether *different* perception will always translate into *better* performance. The cognitive bias 'Einstellung' effect refers to circumstances in which familiarity with a problem can lead to a familiar solution interfering with the achievement of a better one.

Online test hypothesis via ChessQuiz

We tested a hypothesis via an online test: Chess players make better decisions if prompted to consider candidate moves compared with players who are just asked to find the best move.

Thereby we used as a definition of candidate moves: Candidate moves are the moves that deserve attention in a given chess position.

To explore this hypothesis we developed an online test with tactical positions in English.

This was done via ChessQuiz, a program developed by Laszlo Moldovan (copyright Chess Academy Apeldoorn). The 207 participants who completed the test were divided in two groups. They solved online twelve positions, with 10 positions counting for their test scores.

In the experimental condition participants were asked explicitly to use the method of candidate moves. This was explained by giving our definition of candidate moves. In the other condition they were asked to play the best move.

ChessQuiz Test Results

We did not find evidence that chess players make better decisions if prompted to consider candidate moves, compared with players who are just asked to find the best move

There are a number of reasons why we may have failed to observe the predicted effect in this study.

One potential limitation of our design has to do with the nature of our control group: In the control group we cannot rule out the possibility that participants know about candidate moves and used this method to some degree.

Maybe asking participants to do a task which is new for them can be confusing and/or time consuming.

It is possible participants in the candidate move group may not have been applying the method as we intended.

Also unfamiliarity with the approach could complicate our results. Though the use of candidate moves may be beneficial if one has some training in how to apply it, it is possible that any participants in our experimental group who had not used this method before found it cumbersome, weakening their performance.

Taken together, these observations lead us to wonder if explaining in just a few sentences what the candidate move method is may not have been sufficient to improve performance in our task.

Answers to the open questions of the test

Many answers were very short like yes and no.

In the experimental condition of 67 respondents 50 answered they knew the candidate moves method, and 47 think it is useful.

The question if respondent use other methods for search strategy led to all kinds of answers like check/captures/threats, pattern recognition, heuristics, looking for the opponent's plan, forcing moves, elimination, comparison, prophylaxes, random looking, king safety, sound moves, winning combinations, inactive pieces, intuition, imbalance in position, tactical motifs, Buhmann's 4x4-method, just look at good moves, just raw calculating

In the control condition the 73 respondents named all kinds of search strategies they use: forcing moves, intuition, recognize patterns, calculation, looking for candidate moves, piece activity, looking for threats, looking for preferable position, look for checks and combinations, finding key ideas in positions, looking for mate, looking for undefended pieces, intuition, double checking, start with most promising moves, finding weaknesses in position opponent, elimination, comparison, forcing combinations, harmony, king position, endgame transposition, looking for sacrifices.

Interview GM Liam Vrolijk and GM Thomas Beerdsen

While their trainers used the candidate moves method when training young grandmasters Liam Vrolijk and Thomas Beerdsen, Vrolijk and Beerdsen don't use candidate moves consciously when considering moves and plans. They assume they think very concretely, more so than older grandmasters. This is probably influenced by training with computer engines and in their case by growing up with the Dutch Steps method which is mainly based on tactics. Also, nowadays openings become more and more important and concrete variations play a great role in them.

Problems and studies are rich in candidate moves

Solving endgame studies and even mate problems are instrumental in improving tactical and calculating skills, creativity and out of the box thinking in general and spotting candidate moves in particular. Endgame studies provide a player with a range of attacking and defensive weaponry. Leading trainers use solving studies as an important part of their training program.

DISCUSSION

Candidate moves are the moves that deserve attention in a given chess position. Choosing candidate moves is multifaceted. It is about a concept as well as methods. Multifaceted means it is about using

the right methods and techniques in the right situation. Pattern recognition plays a crucial role in recognizing possibilities and limitations while evaluating positions.

If choosing candidate moves is multifaceted, what does this mean for further research and application of insights in chess training?

If it is multifaceted it could be a reason to do research about more specific chess positions and technical methods in relation to more specific groups (self-management, motivation, intelligence, training experience, playing strength, gender, stage of development for example). And about different aspects like conscious and unconscious thinking, memory, and social circumstances like cooperation with partners and trainers. Besides this research about the role of heuristics in thinking could give us additional insights.

For the neural underpinnings (neuroscience) of chess performance and expertise we have miles to go, although for example perception research and brain research give insights. It seems educational and cognitive psychology brings us the most insights for the moment.

Mark Dvoretsky advised to develop your own techniques for decision making. Kotov held a plea for a more scientific basis for chess training.

For Chessable a useful next step is to create a course about candidate moves.

This will be combined with a Thinking Tools Chess Alphabet, which consists of an introduction and a list of thinking tools, based on a combination of psychological insights and experience via best practices. Each tool has a theme, explanation, example and practical advice. These themes can be the use of a diary, working together, acronyms, etc.

From a training perspective it is important to make knowledge explicit, and thinking tools can be instrumental for that purpose.

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