



Learning from Dr. de Groot

Quote of the Month: *"Chess is a mental sport, but there are 1,000 chess books that teach you what you should know for every one that concentrates on showing you an effective way to think."*

COLUMNISTS

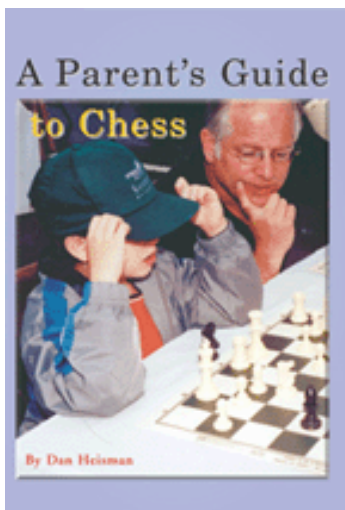
There are two areas I would like to research:

Novice Nook

1) How do players learn/improve at chess?

2) How do players think during their move?

Dan Heisman



It may seem that these two areas are only remotely related, but there is more to it than meets the eye. When you learn to play baseball, you don't just learn about innings, outs, and bases – you are also taught how to bat, to throw, to catch, and to run the bases. But when players learn chess, the only things they are usually taught – even by competent beginner books – are the basic rules such as checkmate and draws, and how to move the pieces. Then they are taught more and more about what the pieces can do. A few guidelines like “At the start of the game try to control the center,” “For your first move, push a pawn two squares in the center,” or “Knight on the rim your future is dim” are thrown in for good measure.

But chess is a thinking game, and almost no beginner is ever taught *how to think* to arrive at their move. No wonder everyone learns their “chess thought process” in a very mish-mosh way that quickly leads to bad thinking habits. I have explored this phenomenon in many Novice Nook articles and even pre-Novice Nook [ChessCafe](#) articles like *The Secrets of Real Chess*. This month we will examine what I have learned from repeating the experiments of the first and most incisive researcher into thought process, Dr. Adriaan D. de Groot. I have been administering his thinking process “protocol” experiment for over 30 years!

Back in the late 1930s, Dr. de Groot, a professional psychologist and chess master, decided to record the thought process of dozens of players of all levels, with the purpose of laying out how everyone thinks, and what are the differences between the thought processes of varying skill levels. Players were given a position and asked to find a move as well as simultaneously verbalize everything that was going through their mind. These recorded processes were called protocols.

After recording dozens of these exercises, de Groot analyzed the protocols in a

very scientific manner. The result was a PhD-type thesis that was eventually translated into English as the book *Thought and Choice in Chess*, now out of print. In that sense *Thought and Choice in Chess* is not really a chess book at all, but a non-layman psychology book about chess. It is a tough but fascinating read, and I persevered enough to plow my way through it in the late 1960's.

Dr. de Groot was able to garner many of the best players of the day to participate in his experiment: Alexander Alekhine, Reuben Fine, Dr. Max Euwe, Paul Keres, and right on down the line to class players. He wanted to find out how they arrived at a move in a typical tournament setting, not to show them “White/Black to Play and Win” positions since the thinking process for well-defined problems is much different:

- In “Play and Win” problems you are not just looking for the best move – you need a move that has a forced win in all variations. If you don’t find one, then you try another move. In these problems you don’t give up until you find a solution because you are told there is one!
- In “Normal” positions, you need to find the best move *in the given time available*, just as in a real tournament game. Weaker players often do not take all of their time for game, but for stronger players the opposite problem is often evident: *proving* the best move on each move throughout the game often takes more time than the clock allows. Therefore strong players must use time management and practical alterations of their maximal thought process to allow them to play all of their moves in the allotted time. This time limitation is one thing that makes chess a sport, as opposed to a “science” where you can take as much time as you wish to prove what is necessary.

Therefore Dr. de Groot selected interesting positions from some of his games and asked the players to come up with the best move in a reasonable amount of time, as if they were playing an important tournament game. He tried to select “rich” positions that would separate the men from the boys. de Groot chose dozens of positions, but most of his work was centered on three, which he labeled Positions “A”, “B”, and “C”.

As a result of this fascinating experiment, Dr. de Groot was the first to prove that, contrary to popular belief, grandmasters do not think deeper than just good players, say those at USCF “expert” level: 2000-2199. What separates the GMs from players at that level is not just the incisiveness of their search – they do it much more accurately and efficiently – but also the number of positions GMs already know how to play: GMs know how to play roughly 100,000+ positions, while masters know only 10,000+. It is much easier to know something than to figure it out. I might add that GMs also *evaluate* positions much better, as we shall see.

Soon after I purchased the book I began tape recording the thought process of chess players I knew – I remember doing this in college, but I think I started while in high school. Today I still use these experiments as part of my teaching, but for expediency I usually just manually record most of the key thoughts. I hope it is not

immodest to say that over the years *I undoubtedly have given the “de Groot Exercises” to many more players than Dr. de Groot!* For the most part I use the same exercises that Dr. de Groot gives in his book, so that immediately after the exercise I can read to students how Dr. Max Euwe or others thought about the same position, and then to compare the student’s thought process to the World Champions’. When I repeat a de Groot exercise with the same student, I of course use different positions, occasionally ones from my own games.

I have also developed a “halfway” exercise I call the DAT-SCAN, which is “Dan-Assisted Thinking”, where I have a student think out loud to find a move but, instead of no interruptions as in the de Groot exercise (where the subject’s thinking process must only be heard, but never affected), in a DAT-SCAN I proactively help them go through a reasonable process.

What have I learned from giving the de Groot exercise hundreds of times? First, I can almost recite Dr. Euwe’s 15 minute verbal analysis of “de Groot Position A” from heart! I have even corrected the typos and de Groot’s stenographer’s mis-recordings of what Dr. Euwe meant. They did not have tape recorders (or today’s digital recorders!) in 1938.

On a more practical side, the following conclusions stand out:

1) No matter what process they think they use, players rated below 1600 USCF almost all practice what I have called “Hope Chess”: they make moves without considering whether they can deal with all the threats their opponent might make *next* move. To put it another way, they *often make a move without at all considering the consequences of what might happen when they do*. They make a move without a Principal Variation (PV) – not wondering or looking to see if their move allows an opponent check, capture, or threat on the next move that might win the game immediately. This was not a surprise to me; it is very difficult to have a rating that low if you have reasonable chess knowledge *and* play “Real Chess” every move of each slow game you play.

As I noted in my Reader Question in a recent Novice Nook, one student recently e-mailed me:

“I identified myself as a “Hope Chess” player when previously I had fooled myself into thinking I was largely past that phase. However, as with the weakest link, if I play hope chess on any move, the game is hope chess. Loosely analogous to 12-step programs, the first step to recovery is to admit that I am a hope chess player.

Yesterday’s walk through my game where I had ignored many relatively simple responses (and only won because my opponent was equally lax) was a terrific eye- opener, as was the De Groot exercise.”

2) In the majority of positions that occur during a normal game, at least some

pieces from the opposing forces can interact. For these positions I advise a student to first consider their most forcing moves - checks, captures, and threats - when identifying candidate moves. However, many fail to realize how important this advice is and don't do so systematically. Weaker players jump all over the place, rarely covering *all* the pertinent lines, such as considering *all* their checks or captures, much less all possible opponent recaptures after a capture. For example, after a capture that allows multiple recaptures they often just *assume* a recapture, never asking "If I were him, which recapture would I really choose?" This mistaken assumption often leads to conclusions that prove very little. Good players don't make this kind of mistake, especially in clear positions where they can work out everything with a little effort.

3) While weak players analyze much worse than strong players, it is the *evaluation* skills that separate the 1800-2100 players from the international players. GM's see immediately which positions are good or bad, and worth further consideration. 1800-2100 players analyze fairly well, but arrive at much less accurate conclusions!

Evaluation is a large part of what separates upper echelon classes from each other, such as grandmasters from experts. Often players rated 1900-2100 used the same deductive logic that GMs did in deciding what is forced and what is not, and what is likely to happen. But then, at the end of the lines, when the GM's might conclude "That is good for me - if I don't find anything better I will certainly be happy with that!" the 1800-2100 player might look at the same position and say, "I am not winning any material and I don't see anything special, so I will probably play another move." So the key is that *players rated 2400+ are not extremely better in analysis than the players in the 1900-2300 range* (don't get me wrong; top players are more accurate and less error-prone!), *but are clearly much better in evaluation*, especially evaluation of "even material" positions. *Therefore GMs and IMs are much more likely to be able to choose the best continuation among several alternatives when the obvious evaluation criteria of king safety and material are not big factors.* Moreover, weak players almost always value pawn structure above initiative and the entire army's activity (see my recent Novice Nook *Evaluation Criteria*), while strong players don't care nearly as much about the pawn structure if they can maintain a clear initiative.

4) Weaker players often evaluate "potential" tactical moves primarily on material, but non-tactical moves on positional grounds. This seemingly minor nuance often turns out to be an unbelievably big mistake! For example, they will reject a capture because "it does not win material", but instead play a quiet move that often fails to force play, allowing the opponent to seize the initiative. Apparently they feel that when a capture fails to win material it does not succeed in its primary purpose, and thus for that reason alone give it a lower evaluation than a non-capture, even if the resultant material is otherwise even in both cases! Of course, this is bad logic; it is entirely possible that the capture leads to a better position than the non-capture. A part of chess skill is seeing how captures which *don't* change the material balance might prove favorable by trading your bad pieces for his good ones, eliminating key enemy defenders, keeping the initiative, etc.

5) Some players spend a ton of time looking at lines that are not forced and almost never could happen. They don't use deductive logic to think, "Suppose I do this – would he really do that? And if so, what would I likely do?" One of my college chess teammates, who shall remain nameless, looked an astounding 40 ply (!!) or so ahead with perfect board vision, saying "Suppose I do this and then he does that, then I will probably do this and suppose he does that and then I do this..." However, the ten minutes he took to do so was a complete waste of time because not only was the *initial* move he was contemplating not necessarily best, but none of the subsequent moves were either. He made no attempt to show that the moves under consideration were best or forced, or why he or his opponent would play them. I would estimate the chances of that entire line occurring as much less than 1 in 1,000,000,000 – completely worthless! *It is much better to spend time analyzing moves and evaluating lines that occur early in the search and that might take place, rather than spend time analyzing moves deep in the search that almost never could happen* – and even if such deep, non-forced lines did occur, you could always analyze them during later moves!

6) Most students love the de Groot exercise and consider it most revealing, while others find it hard to take for the exact same reason: because it so pointedly shows what they are doing wrong. A few months ago I gave the de Groot exercise to an "A" player who made a clear thinking process error that was easy for me spot, due to its clear differentiation from what the GMs did. The knowledge of this serious error in his thought process may have been enough in itself to prevent him from becoming an expert. However, after he was finished and I explained what he did and how that differed from GM protocols, he became indignant and vociferously defended his process. Even when the exercise works and is *insightful*, it is sometimes unfortunately *inciteful*!

7) Weaker players don't statically *evaluate* unfamiliar positions. I define evaluation as looking at a position and determining *who is better, by how much, and why*, and define *static evaluation* as evaluation done before analysis. Many weaker players might mention that one side has an isolated pawn or a weak square – one might call this an assessment - but, without the final *who is better, by how much, and why*, there is no conclusion turning that assessment into an evaluation. Players rated below 1800 rarely include in their protocol anything similar to the following:

"The material is even, the Kings are about equally safe, White has a better pawn structure, but Black seems to have more total piece activity. Since it is Black's move, I think he can take advantage of that activity, so I like Black much better."

Due to your knowledge of prior play, you don't need to make an evaluation before each move when playing a real game but, when starting a de Groot exercise, it is helpful begin with an evaluation. Instead, weaker players often begin their thought process by either making a general assessment with no conclusion or, worse, immediately searching for candidate moves; many do not even count the material. That does not make much sense because, without an evaluation, how do you know

what you might be looking for?

As a trivial example of how an evaluation is helpful, suppose you find a forced draw – would you take it? If you think that otherwise you are losing, you would probably be very happy with the forced draw (in which case you were not worse at all, were you?). But if you thought you were winning, why would you settle for a move that forces a draw? So knowing which side you think is better provides some goals as for your analysis. For a further discussion on this, see my pre-Novice Nook [ChessCafe](#) article *Using Steinitz' Laws*.

8) Another thing a weaker player should do, but doesn't always, is assess the threats generated by an opponent's previous move. Since in a de Groot exercise you are *not* given the previous move, then one needs to look at *all* threats (in a real game you can often shortcut this process by only considering the new threats). The way to do identify the threats is to think, "Suppose it were not my turn, but again my opponent's, then what would he do?" Doing this also helps you find all the opponent's "killer" moves, which are very strong threats that cannot be ignored. Killer moves can eliminate your candidate move from consideration if that candidate move does not meet the strong threat. As a simple but strong example, suppose you see that if you do nothing on the next move, your opponent can play 1...Qh3 with unstoppable mate threats on g2. Then any candidate move that allows 1...Qh3 and then mate must be discarded, and only moves that can meet or prevent this threat are worthy of further consideration.

9) Does a player who plays too quickly slow down because he:

A) Acquires additional chess knowledge and has more to think about, or because he

B) Knows he can play a lot better if he plays slower?

De Groot exercises showed me that for many, A is not the primary reason, although both usually apply. I rate the weight between these two as approximately 35%-65%, Reason B predominating. For example, suppose I teach someone "X" things they should think about every move, but they still play so fast that they could not possibly be thinking very much about those X. Then surely adding "Y" additional factors to consider so they now have "X+Y" will *not* slow them down - it might intimidate them so they are even less likely to think about the X! It is clear that for players who do "X" that Reason B is correct - they need to "buy" into the correct thinking process in order to slow down - teaching them more things to consider during their move gets severely diminishing returns, if not negative.

Sometimes a player's motivation to slow down depends on how much fun the extra or correct thinking is, and how much he wants to improve and is willing to do the work. Once you are aware of what is involved, it is not magic to begin to practice a good thought process – and doing a minimal amount every move religiously is required for high level slow play.

One thing that often slows down players who play too quickly is peer pressure. Over-the-board players seem to learn to slow down better than internet-only players because they go to strong tournaments and see all the good players taking their time! This sometimes works wonders, as adults don't want to be the first player done each round, and thus learn to "imitate" the time management of those around them.

10) Even intermediate level tournament adults don't always follow the advice, "If you see a good move, look for a better one – you are trying to find the best one." Often they just calculate to see if their intended move is reasonable and, if so, they immediately make that move. But this is also a big mistake. On most moves that require analysis, **the goal of your thought process is to prove that you have found the best move, not to show that a move that attracts you is reasonable!** Proving that a move is reasonable is not an efficient way to find the best move, and is also a reason why some players play too fast.

In *Thought and Choice in Chess* de Groot identifies four phases of the thought process of stronger players and calls them: 1) Orientation to Possibilities, 2) Phase of Exploration, 3) Phase of Investigation, and 4) Striving for Proof. Weak players rarely go through all – or sometimes any – of these phases. And intermediate and weaker players almost never strive for proof, "proof" meaning they have systematically gone through the process of showing that the move they are about to play is better than any of the other candidates (that is *leads to a better position, by force, than the others do*), and thus is really the best one.

In addition to the lessons I learned from administering de Groot exercises, what should the average chess player learn as well?

After doing a de Groot exercise, students who listen to Dr. Euwe analyze the same position always get an eye-opener! But, despite the imposing depth of Dr. Euwe's thorough analysis, it is actually quite easy to emulate his *process*. Thus everyone who hears this process can and should strive to do something similar. The hard part, of course, is not emulating the process, but picking up all the extra knowledge that allows one to analyze and evaluate well, and to get good results from it! It takes years of good practice and judgment refinement to be able to evaluate a position well, and more years to be able to do so with anywhere near the sophistication of a GM, even if you have the capability. It does not take nearly as long to learn how to *analyze* well, but even that is almost always measured in years, and not weeks or months, as so many players would wish. The amount of work it takes to analyze well is much higher than most players realize, or possibly even find fun. After students listen to all the work Dr. Euwe did to find the best move, some of them wonder "Do I really want to do all that?!" That is a reasonable reaction: *If you do not find extensive analysis and delicate evaluation fun in positions that demand it, then you probably won't do it now or ever.* However, unless you change your preference, your chances of ever becoming a very strong player are likely nonexistent.

The average player also often realizes that the gap between him and top

players is larger than previously imagined. Many players fool themselves into thinking that if they studied more openings and endgames for a few years that they could or should or would eventually move up 1000 rating points or so. I think doing the de Groot exercise is an epiphany that shows that there are more important things to do in order to get really proficient at chess than just learning some new moves in the Caro-Kann or rook-and-pawn endgames. Not to say that opening and endgame study isn't important, but how many players do you know that have played 10+ years, read 100+ books, can quote chapter and verse on book knowledge, and yet are still rated 1500 or not much higher? Without even testing them, I can tell you that these players have a poor thinking process and will never get much better until they correct it.

Finally, I get a lot of inquiries about what is a minimally correct thought process for a typical slow game position, as opposed to the detailed process I discussed in the Novice Nook *A Generic Thinking Process*. There is no one correct answer, but here is a try:

1. After your opponent's move, ask yourself "Why did he do that?" and "What are all the moves he can do which he could not do before?" Concentrate on opponent's moves and ideas that can really hurt you. Obviously if he made a check you need to get out of it, and if he made a capture you likely need some sort of recapture, possibly next move after a *zwischenzug* (in-between move). However, if his move is not a check or capture, look for the *threats* it created. These are found by asking, "Suppose I pass and he just moves again. What could he do to me that I would not like?"
2. To begin looking for *your* move, consider moves that meet his threats, as well as your own checks, captures, and threats. If there are none of consequence, consider the plan of making your army more active, especially identifying your piece which is doing the least and finding a move or plan which makes it do more or, conversely, moves that restrict your opponent's mobility. Another plan is to find moves that take advantage of opponent weaknesses or your strengths. Don't waste time on grandiose plans that are not, to paraphrase IM Silman, both feasible and effective. Discard potential threatening moves that are easily met by opponent replies that leave your position worse than before. The list of reasonable moves you generate are called *candidates*.
3. Find the checks, captures, and threats that your opponent could reply *after* each candidate. If he can make even one move that you cannot meet, then that candidate should likely be discarded.
4. For each of the remaining candidates, assume your opponent will make *his* best reply (not an easy task!) and try to figure out what (short) sequence is likely to occur. Visualize the position at the end of that sequence and evaluate it. In order to evaluate a position, it usually should be a quiet one and not in the middle of a checking or capturing sequence. For unclear sacrifices you just have to use your experience and judgment. Do *not* make the common mistake of evaluating the position immediately after the candidate move, ignoring opponent's replies and

how to meet them! If your sequence is reasonable (for both sides), the evaluation at the end of the sequence should also tell you how much you like that candidate move.

5. *If you see a good move, look for a better one!* After performing #4 for each candidate, compare the evaluation of the resulting position with the evaluation of the best position you have found so far, the “king of the hill”. If the new move’s position is even better, it becomes the new king of the hill.

6. Once you have finished evaluating all your candidates, your move of choice is the one that starts the sequence leading to the position that was the final king of the hill! The sequence of moves you found for that “best” move is called the Principal Variation (PV). A PV is the sequence that ChessMaster 9000, Fritz, and other chess software engines display as their top analysis line. Your evaluation of the positions in the PV also becomes your *dynamic evaluation* of the current position. For example, if you see that the PV wins by force, then your current position must be winning!

7. Do a sanity check. Over the board, you can write down your move, close your eyes, and/or take a deep breath. Re-examine your move with fresh eyes. Is it just crazy? Does it leave a piece *en prise*? Miss a mate? You should not try to redo your entire analysis of the written move. If the move *is* crazy, cross it out and reconsider, starting with the “second-best king of the hill”. If it is not crazy, make the move, hit the clock, and write down your time remaining for the game beside your recorded move.

The above process would *not* be used for all kinds of moves. Exceptions include: the only moves to get out of check, book moves, mating with a Queen and King vs. King, etc. But for moves where real decisions have to be made, it is not a bad outline. Hope this helps!

Dan welcomes readers' questions; he is a full-time instructor on the ICC as Phillytutor.



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