CHESS THINKING SKILLS IN CHILDREN

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Background

As related in my previous paper, *Chess, Piaget and Polgár*, I was concerned about the relatively low level of achievement of children in school chess clubs, and believed the main reason for this to be that to play good chess requires higher level thinking skills which children naturally only reach at the age of about 12.

A few years ago I set up a quiz with eight questions, specifically designed to test children's chess thinking skills. For each question students had to give their move, along with their reasons for making the move, using either words or variations. I didn't keep the results at the time, but as my interest in the subject of how children think at chess and decide on their moves was growing, I resurrected it.

Methodology

The test was administered at various times in school chess clubs and at Richmond Junior Chess Club, and also with a few private pupils during Spring 2003. Children were allowed about 30-45 minutes to complete the test. A few of the less experienced players who were doing the test with me on a one-to-one basis were given a small amount of prompting.

For the purposes of this article we will be considering six of the eight questions. Children are not identified as individuals but their answers are classified as follows:

SHM – Sheen Mount School Chess Club. Most of these children were in Year 5 (aged 9-10) at the start of the test and had been playing at school for about 2½ years. In addition, many of them have regular small group coaching with the former head teacher of the school. Internal results indicate that this is one of the strongest primary school chess clubs in the Borough of Richmond.

VIN – The Vineyard School Chess Club. Again, one of the stronger school chess clubs in Richmond, perhaps very slightly weaker than Sheen Mount. Again, most of the children doing the test were in Year 5.

CHR – Christ's School – a comprehensive school in Richmond. These children were mostly in Y7 (aged 11-12) – some had been playing for several years at primary school chess clubs, others had less experience.

HCH – Hampton Court House – a small independent school which offers one-to-one chess tuition to all its students. These children were mostly less experienced and weaker players than those at Sheen Mount or Vineyard.

RU9 – members of the 2003 Richmond Under 9 squad. Children mostly in Y3 or Y4 (one in Y1) who were in, or close to selection for the Richmond EPSCA U9 team. Most of these were tested during a squad training day, the others during private tuition.

RJC – members of the Advanced Group of Richmond Junior Chess Club. Varying ages from 8 to 14, and playing strength from about 50 to 100. Most of the testing was done at Richmond Junior Chess Club, some during private tuition. Two stronger players who completed the test at their schools were included in this category.

This survey is based on a total of 75 scripts, not all of which were complete. I used a marking scheme of one point for a correct answer, with an additional one point for a partially correct reason, or two points for a completely correct reason. Two children took the test twice, obtaining near perfect scores on the second occasion.
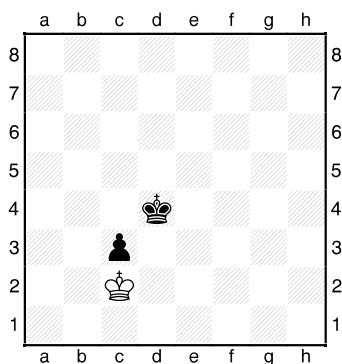
Levels of Thinking

As readers of my previous paper will be aware, Piaget identified four levels of cognitive development in children. For the purposes of this paper I'd like to identify four levels of chess thinking.

Suppose your knight attacks my queen. At the first level I do nothing about it, either because I don't see it or because I don't realize that queens are more important than knights. Let's call this level NON-LOGIC. At the second level I move my threatened queen to another square, but don't check that that square is safe. We'll call this BASIC LOGIC. Next, I will move my queen to the first safe square I see – SIMPLE LOGIC. Finally, I will identify ALL the safe squares for my queen before making my choice. I will also look at other move – perhaps I can effectively counter-attack your queen, or maybe I have a checkmate myself at the other end of the board. I will then consider all reasonable moves, both statically (the effectiveness of the square itself) and dynamically (looking ahead to consider your possible replies in each case) before making what I hope will be an informed choice. I believe this to be the chess equivalent of Piaget's fourth level – formal-operational thinking, and will call this COMPLEX LOGIC. Under the heading of COMPLEX LOGIC I would also include any form of thinking ahead along the lines "I go there, then he goes there, then I go there". My hypothesis is that children under the age of 12 will, without tuition and practice, find this sort of thinking beyond their capabilities.

Another element of chess thinking prevalent at this level is to play a move solely to tempt the opponent into making a mistake. This may take the form of playing a move because it attacks a piece (even if that piece is defended), or moving a piece to a square where it is defended but could be taken. I've even seen children doing things like 1. e4 h5 hoping for Qxh5. I call this phenomenon WISHFUL THINKING.
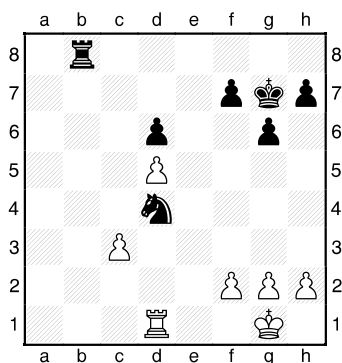
The Questions

Q1 is the most important position in chess. It can be solved correctly either because the student has seen the position before and knows the answer, or by calculating a few moves ahead. According to our hypothesis, children in Primary School chess clubs will find the calculation beyond

them. In fact most of our Schools Sample, and almost all of our Club sample have been shown this position before. Will they remember the answer?

As expected, the School players are unable to make any attempt to think ahead, and, not remembering the position, are reduced to guesswork or wishful thinking. WISHFUL THINKING comes into it. "Kb3 because if the pawn moves it gets taken." (SHM) "Kc1 because if the pawn moves forward you can take it." (VIN) Of course, this is true of all four of White's possible moves. Others vaguely think they want to stay near the pawn and away from the king. "Kb3 to stay near the pawn." (VIN) "Kc1 because it's away from the king." (SHM) "Kd1 because it's moving into an open space and I'm not cornering myself." (HCH) Then there are the vague statements: "Kc1 because you would be safe." (CHR) "Kd1 because it's a good move." (VIN) The closest to an intelligent school answer is "Kc1 because they can make a mistake and then it's stalemate." (SHM). The Club players did a lot better. Some of them remembered the magic word OPPOSITION. "Kc1 because if Kd3, Kd1 giving opposition to the black king, c2, Kc1, black has to go Kc3, stalemate." (RJC) Others remember that you have to go back to the queening square: "Kc1 because it is on the queening square." (RU9). Some try to give analysis but, even with the minimum force on the board get confused: "Kc1 because it will be a draw because if the king goes to d3 wherever the white king goes it would force a draw." (RJC) Of the RJCC sample there were 17 correct and 3 incorrect answers. 11 out of 16 of our Richmond Under 9 sample were also correct. There were six correct answers out of 14 for Sheen Mount, but with little evidence of more than guesswork, and only two out of 11 for Vineyard. Christ's scored 3/5, and Hampton Court House 3/9.
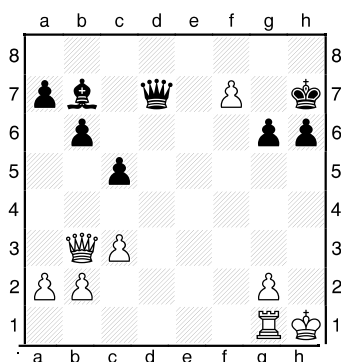

In Q2 White is faced with a simple choice of captures. The back rank mate is very familiar to almost every player. Will they recognize this and avoid the more natural rook capture? I have used this position a number of times over the past 15 years, and there is always a significant minority who, instead of capturing the knight, move a king-side pawn. This typifies what happens when young children try to think ahead. Instead of "I go there, then he goes there, then I go there" they think "I go there, then I go there, then I go there". There are also one or two, mostly stronger players, who assume it's a trick question and decide that they have winning chances by playing c4 and creating a passed pawn.

This proved to be the easiest question in the test, however, and many of our school sample got it right. Some of them, though, did not make the reason for their choice of capture clear. At Sheen Mount there were 8 votes for the pawn capture, four for the rook capture and one for g3. "Rxd4 wins a knight for free." (SHM) "Rxd4 to get my rook in play." (SHM) "Rxd4 because it would be a move where no-one can mate." (SHM) "cxd4 because it takes the knight." "g3 – it gives the king a getaway." (SHM) But some gave the correct answer: "cxd4 – now my rook is still protecting white's king." "cxd4 – if you move your rook up a rank black has checkmate." (SHM) At Vineyard, five took with the pawn, three

with the rook and there were three other answers. "Rxd4 because you capture an enemy piece." (VIN). Most here had seen the back rank mate: "cxd4 then you take a piece and don't expose your king." (VIN) "cxd4 so if they move Rb1 you can take it." (VIN) "g4 to make an escape route for the king." (VIN) At Christ's we saw three pawn captures and two rook captures. "Rxd4 because your rook would be safe." (CHR) "cxd4 to take the knight without giving checkmate to the opposition." (CHR) The less experienced players at Hampton Court House came up with six rook captures and only three pawn captures. One player has a positional reason for his choice: "Rxd4 because I don't like two pawns in a row." (HCH) "Rxd4 – I take a piece for free and the rook is protected." (HCH) The Club sample, however, almost all get it right. The Under 9 squad have 11 pawn captures, one rook capture, three king-side pawn moves and one c4. The stronger sample come up with 15 pawn captures, one rook capture, two king-side pawn moves and two c4s. Typically: "cxd4 because if you take with the rook you lose to back rank mate." (RJC) "cxd4 it's winning a piece and stopping checkmate." (RU9) and many others in similar vein. But also: "h3 – I might do this so I can take the knight." (RU9) and "h3 – threatens knight so that the rook would be free." (RJC) "c4 because if you take the knight you cannot advance your pawns." (RJC) "c4 because it's a decoy and an attack for getting a queen." (RU9)
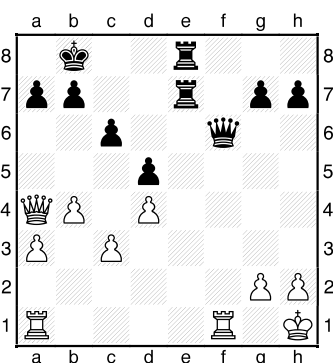

Q3 is difficult – will they see Black's (not immediately obvious) mate threat or just queen the pawn? In fact this question is a very good predictor of the possession of COMPLEX LOGIC skills. Almost all our school sample, as well as most of our Under 9s don't give it a second thought. The standard reply from school players is: "f8=Q because then you get a queen." (SHM, and others). "f8=Q so that you have two queens so you will have a better chance of winning the match." (SHM) "f8=Q so you have a better chance." (RU9) "f8=Q because it will build pressure on the king and queen with more of the better pieces." (RU9) "f8=Q – you get a queen in a very strong position for a checkmate." (CHR) Some take it further: "f8=Q because then I'd get checkmate next move. " (SHM and others) "f8=Q because then you win in a few moves." (VIN) "f8=Q to get a queen and move queen b3 to g8 and get checkmate." (CHR) "f8=Q because I then get a queen. Then I move my rook to f1. Finally I move my rook to f7 which is checkmate." (VIN) These players are falling into the classic "I go there, then I go there, then I go there" trap.

Others don't consider promoting the pawn at all. Rook moves are popular: "Rd1 to attack the queen. The pawn f7 and the rook d1 will be defended by the queen." (VIN) "Rf1to support the pawn. If black plays Kg7 I can queen my pawn immediately." (RJC) Some see the threatened mate and think that a rook move will prevent it. (Yes, but only for one move.) "Rf1 because otherwise it would be Qh3#." (RJC) "Rf1 because it doesn't let black mate and protects the pawn." (RU9). Some find better defences to the mate threat: "c4 because otherwise I am mated (f8=Q Qh3#) – by advancing this pawn my queen protects h3." (RJC) "Kh2 because black is threatening checkmate on h3 and if rook anywhere to give room for the king, Qh3+ Kg1 Qxg2#" (RJC) "Kh2 because it stops checkmate and c4

loses a pawn and moving the rook would be checkmate." (RJC) Only a few give the right answer, but not all of them have seen the mate threat. "f8=N+ so that you can make a fork." (VIN) "f8=N+ because you get an extra knight and a queen rather than a queen." (RJC) Finally: "f8=N+ - promoting to a knight forces black king to move and wins Q. If f8=Q black wins with Qh3#. .White can't play gxh3 because of bishop on b7." (RJC). In all, Sheen Mount had 11 queen promotions and three Rd1s. Vineyard had one correct answer, seven queen promotions and three other moves. Christ's promoted to three queens, with two Rf1s. Hampton Court House had one correct answer, six queens and two others. The Richmond Under 9s managed only two correct answers, ten queens and three others, while the older/stronger Richmond group had nine knight promotions (mostly the leading players), only three queens and eight others.
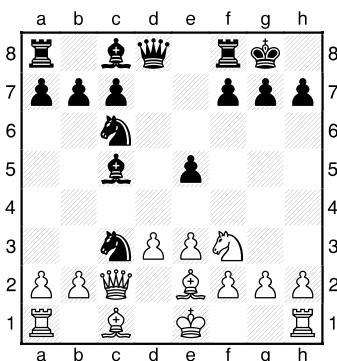

Will the players who saw the back rank mate in Q2 see it again in Q4 and refrain from taking the queen? The answers fall into three categories. The weaker players snap at the bait without giving any indication that they've considered Re1+ in reply. The intermediate players refrain from taking the queen because they calculate 1.Rxf6 Re1+ 2.Rxe1 Rxe1+ 3.Rf1 Rxf1#. The stronger players (of whom there are only a few, and who are to be found exclusively among the older Richmond club sample) see 1.Rxf6 Re1+ 2.Rf1.

Seven Sheen Mount players, four from the Vineyard, five from Hampton Court House, three from Christ's and six Richmond U9s took the queen. "Rxf6 because you get a queen." (SHM and others in similar vein) "Rxf6 because a queen has a better rate than a rook does." (SHM) "Rxf6 so that you can win but it will be hard because he has two rooks so you will play extra hard." (SHM) "Rxf6 because you could win their queen." (CHR) "Rxf6 so you get a queen and then a pawn." (HCH) "Rxf6 – take best attack for 2nd best attack almost as good." (RU9) Also one of the older Richmond players: "Rxf6 – it will weaken him and I could control the centre better." (RJC)

The second group included the remaining school and Richmond U9 players, along with ten of the stronger Richmond group. Several players think Black has a threat and react accordingly. "Qd1 because he's threatening 1…Qxf1+ 2.Rxf1 Re1 3.Rxe1 Rxe1#' – Qd1 defends it." (RJC) "Qd1 so you can take the queen and stops 1…Qxf1 2.Rxf1 Re1." (RJC) "Qd1 because black goes Qxf1 Qxf1 and the position's boring." (RU9) "Qd1 because it defends the rook and if the queen takes it the two black rooks can't do checkmate." (RU9) "Qd1 because it stops the mate." (RU9) "Qd1 because it saves the game." (SHM) "Qd1 – it defends the king." (VIN) "Qd1 – it brings your queen into a stronger position to block the attack." (CHR) In total, Qd1 received 19 votes, 5 from Richmond club players, 9 from Richmond U9s and 5 from the schools. Others choose other ways of securing their back rank:: "h3 – it makes a flight square" (SHM) "h3 to prevent mate and threaten Rxf6." (RU9) "Kg1 to protect the rook on f1. Also so king can't get checkmated on back rank. Also if the black rooks come down you can capture them." (RJC) Finally, a few have a

completely different idea. "b5 getting the queen on a good square attacking lots of other squares." (RJC) "b5 because if the c-pawn takes you take back with the queen, white moves his rook to b1, if the black rook on d7 moves you get checkmate." (RJC) "Rab1 – I move b4 out of its file by moving it one square forward and in 2 moves get the queen to b7 checkmating the king." (VIN)

Only eight of the stronger group found the right answer for the right reason – and some of those admitted that they had seen the position before. "Rxf6 wins queen plus if Re1, Rf1 replies." (RJC) "Rxf6 – white gains a queen and if Re1_ Rf1 is an x-ray." (RJC)

Q5 again offers a seemingly simple choice between two recaptures. How will our sample make their choice?
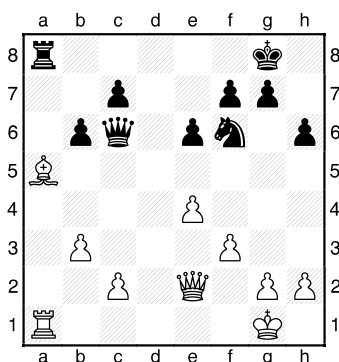
Before we look at the captures, there are some who have other ideas. A few don't seem to see that they can take on c3. "0-0 – protect your king." (VIN) "0-0 for more protection." (SHM) "Bd2 to threaten him." (RU9) Some see a checkmate coming up: "Ng5 so your pieces are set up." (SHM) "d4 to win a piece and get my queen in the game." (SHM) "d4 – allows the queen to move which could lead to checkmate." (CHR) Some of the stronger players mistakenly think they are looking for a fork trick: "Nxe5 – 1.Nxe5 Nxe5 2.Qxc3 Qd5 3.d4 wins a piece and a pawn." (RJC) "Nxe5 – after 1…Nxe5 2.Qxc3 Bd6 to defend the knight on e5. If black does not respond by taking the knight on e5 then white can recapture the knight on c3. If black tries to win a piece by 1…Nb5, Qxc5 leaves white a pawn up." (RJC) "Nxe5 because you can play d4 forking the knight and bishop." (RJC)

Of those who capture on c3, there is an overwhelming majority in favour of taking with the Queen, the choice of 42 out of the 72 who attempted this question. Some give no reason for their choice of capture. "Qxc3 because I get a knight." (SHM) "Qxc3 – ending threat and gaining knight." (HCH) "Qxc3 because I have an idea." (HCH) "Qxc3 because you win a good piece." (VIN) Some want to make sure their queen is not en prise: "Qxc3 – no one can take the queen." (SHM) "Qxc3 because you're safe there." (CHR) The next group are attracted by the idea of attacking the bishop. "Qxc3 – you get a free knight and attack the bishop on c5." (RU9) "Qxc3 to get the knight and get the bishop next move." (RU9) "Qxc3 because later in the game I could get a bishop or rook." (SHM) Some see the attack on the pawn on e5 as well. "Qxc3 because it wins back a knight and attacks a bishop and a pawn." (RJC) "Qxc3 – attacks bishop and pawn again. Also threatening pawn on g7 if the pawn on e5 is captured." (RJC) "Qxc3 – it will weaken him and make my queen attack more and will attack the bishop and pawn." (RJC) "Qxc3 because it forks the bishop and pawn and the knight is attacking the pawn so the knight can take the pawn without the knight taking it for free." (RU9)

Only 14 chose to take with the pawn: 10 from the stronger Richmond group, three from the Richmond Under 9 group and one from Sheen Mount. Some gave no real reason:

"bxc3 – now he can't take white's bishop." (SHM) "bxc3 because you will gain a knight for free." (RJC) Some made their choice for positional reasons. "bxc3 because there is a saying take towards the centre and white gains a knight and white has a semi-open file." (RJC) "bxc3 because it doesn't get your queen into the centre and helps you play d4." (RU9). It's only the stronger players who notice the most important reason for preferring the pawn capture. "bxc3 because if Qxc3 then Bb4 pinning the white queen." (RJC) "bxc3 because it takes a knight and if queen took bishop he would play Bb4 pinning and winning the queen." (RJC)

In our final question white's bishop is attacked and pinned, but can move to c3, defending the rook. You have to see 1.Bc3 Rxa1+ 2.Bxa1 and 1.Bc3 Qxc3? 2.Rxa8+. Most of the stronger players had no problem but the weaker players found it beyond them.

Five players (four from schools, one Richmond U9) just choose a random bishop move. "Be1 because it's *en prise*." (SHM) "Bd2 to save my bishop." (SHM) "Bb4 to get your bishop safe." (RU9) A popular choice is e5 – expecting black to take the bishop when they will take the knight. "e5 because you attack the knight." (SHM) "e5 to exchange his knight." (CHR) "e5 – I put pressure on the knight." (VIN) "e5 – so you get a chance to protect your bishop by constantly attacking with your attacked pieces." (RJC) "e5 because if Rxa5 Rxa5 bxa5 exf6." (RJC) But no one considers how to meet Nd5. In total e5 received 13 votes, 10 from schools one Richmond U9 and two other Richmond players. Qc4 was the choice of three school players – I would have expected more. "Qc4 – to put the black queen under threat." (HCH) "Qc4 to attack the queen safely." (VIN) Two Sheen Mount players resort to wishful thinking: "Ra4 so if black takes white's rook white can take black's queen." (SHM) Four (two Hampton Court House, two Richmond U9) prefer Rd1 – in some cases thinking they have a back rank mate. "Rd1 – it's about to be mate." (RU9) "Rd1 because if Rxa5 you can move to d8 and trap the king." (RU9) "Rd1 – getting a strong grip on a convenient line." (HCH)

Eight give up on finding a good bishop move and content themselves with b4. Of these, four are from schools, three Richmond U9s and one older Richmond player. "b4 because if black takes the bishop it's defended." (SHM) "b4 because you're defending a piece." (VIN) Four, three from schools and one from Richmond, prefer to defend the bishop with Qd2: "Qd2 to get the open file." (SHM) "Qd2 – you're protecting all your pieces." (CHR).

Finally, Bc3 was chosen by 16 of the older/stronger Richmond group, seven Richmond U9s, and just four school players. Some just play it because it attacks a knight: "Bc3 – bishop out of threat and threat to knight." (CHR) "Bc3 because it attacks the knight on f6." (RU9) Again, only the stronger players play the right move for the right reason. "Bc3 – I would do this to defend the rook and to threaten the rook." (RU9) "Bc3 – white will not lose his bishop or knight." (RU9) "Bc3 – it's an attacking and defending move. After a possible Rxa1+, Bxa1 and still threatening black's knight." (RU9) "Bc3 – defends the

rook, attacks the knight and lets the white rook take the black rook." (RJC)"Bc3 – if bishop anywhere else you lose the rook on a1. Now if Rxa1+, Bxa1. If Qxc3, Rxa8+." (RJC)

Conclusions

There was no evidence at all from these questions that our school players were displaying anything remotely approaching COMPLEX LOGIC. For the most part they were reacting to the first thing they saw on the board. They were making very little attempt to look ahead except when the y recognized a familiar pattern such as BACK RANK MATE in Q2 and Q4. And when they did try to look ahead they ended up getting very confused. In several questions we encounter typical thought patterns. In Q3 many of our subjects said that they would play f8=Q followed by Qbg8# without indicating what their opponent might do next. In Q4 several players had the plan of Rab1, b5, Qxb5 and, when the rook on d7 moves, Qxb7#. And in Q5 they ignored the recapture to play d4, Ng5 and Qxh7#. Another flaw in their thinking is to assume that if a capture is possible it must be made. The only players who solved Q4 correctly for the right reason were those approaching 80 strength or above. The others, if they saw 1.Rxf6 Re1+, automatically assumed they had to play Rxe1 in reply. It was also interesting to see how many players thought that Qxf1+ followed by Re1 was a threat. One of the most informative questions was Q5, where our school sample were choosing between two captures for purely static reasons. Considering both alternatives, and looking ahead to see Bb4 in reply to Qxc3 was way beyond their capabilities.

At this primary school chess club level children may recognize a pattern in a position and react to it. Otherwise, their typical responses when asked for a reason for a move include:"Because it's check." "Because it takes a piece." "Because it's safe." "Because it weakens his position." "Because it puts him under pressure."

If you put a group of concrete-operational thinkers (who are capable of SIMPLE LOGIC) together and get them to play chess they will not, by osmosis and through chess, develop into formal-operational thinkers (who are capable of COMPLEX LOGIC). There are several ways in which chess can be used to teach complex logic – for instance regular puzzle solving or talking through a game with a player using complex logic, but putting them in a room with some chess sets will not have this effect. But the traditional lunch-time or after-school chess club, on its own, will not have that effect. Chess teachers and organizers always exhort their children to 'play slowly' and 'think before you move'. But advice of this nature is, to a concrete-operational thinker – rather meaningless. The effect will probably be that they forget what they were going to do and actually play worse as a result of trying to play slowly.

If we want children to derive real benefit from chess, and to continue playing beyond Primary School, we have to consider radically different ways of teaching, organizing and promoting chess. And my suggestions for this will form the basis of future articles in this series.