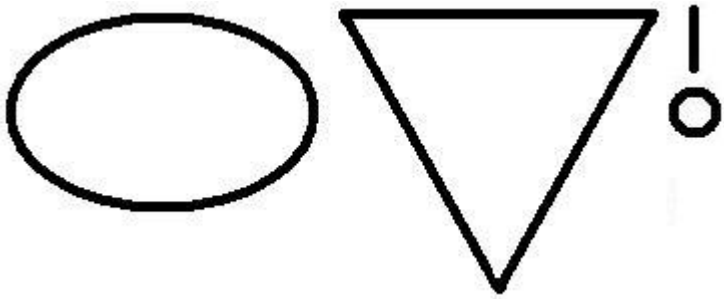
Rotatable Icons, and Chess Diagrams for the Blind

I have worked for the acceptance of chess960 by the USCF executives and membership at large. Underlying those efforts is the philosophy that tradition does not automatically make something right or the best. In this essay I venture to a topic that relates to the forces of tradition and transition.

Stating the Obvious

One human psychology experiment I helped run in graduate school involved the well known phenomenon that an individual human face is hard to identify when it is rotated upside down, even if the face is that of a famous person. But with simple geometric shapes that problem does not exist. As proof...

Dear reader, are you able to comprehend or identify the following three shapes, or is it somewhat difficult for you? In case it is difficult, I have provided the answers immediately after the diagram:



For those of you who could not identify the above three shapes, they are oval, triangle, and line over circle.

Yes I know this little demonstration is silly. But I am making a point against a potential objection further below. I reject the claim that the triangle is upside down and is therefore hard to perceive. I reject that circle over line would be any easier to perceive.

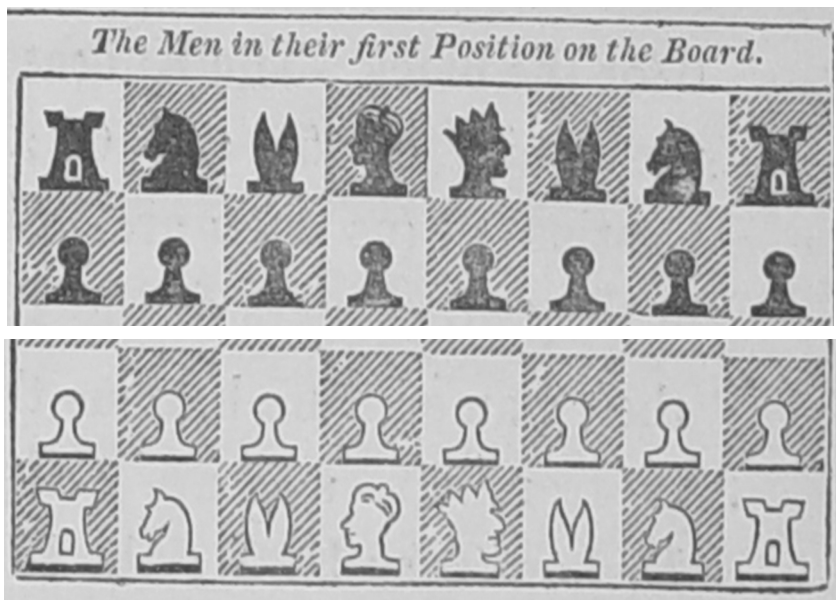
History in High Resolution

Many historians have documented that Nathaniel Cook engineered the Staunton design of the wooden chess pieces in 1849. Cook's primary engineering goals seem to have been two fold. First, the design had to be economical to produce. That meant roundness was essential so as to facilitate turning the pieces on a lathe. Second, each design had to be simple, in a good sense of the term.

Competing designs at the time were excessively ornate. One notable competing design appeared around 1790, and was the handiwork of John Calvert. Calvert's pieces tended to be tall and skinny. Calvert's king and queen could be highly ornate. For the purposes of this essay we make particular note of Calvert's bishop design.

Today's bishop piece has one shallow groove cut into one side of the bishop's top. The groove is modest enough that it cannot be seen from the opposite side, causing the bishop to then look too non-descript (I would prefer a groove on each side). In contrast, Calvert's bishop had one deep wide groove cleaved down the center of the bishop. I wonder whether Calvert's bishop design was influenced by the bishop icon used in Andre Philidor's 1777 book *Analysis of the Game of Chess*, the premier chess book of the 1700's. The bishop icons in Philidor's book also feature a major gap down their middle.

Below is a pair of images, made from one diagram published in an 1817 reproduction of Philidor's book (rows 3-6 cut for space). We see that these old Black icons had almost no white trim (the rook and queen show slight trim). I suspect it was quite intentional to have the king and queen face opposite directions, to help keep them easily distinguishable. The king's top somewhat resembles the top of the modern queen.



Above: Icons from Philidor's book.
Did this bishop icon influence John Calvert's design for his wooden bishop piece? (See Jon Crumiller's ChessAntique.com)

Unknown Icon Designers: We know Nathaniel Cook designed the Staunton pieces. Do we know who designed the icons used in the Philidor book diagrams? The basic design for the icons we use today was settled around 1800. Who designed those icons, and what were his engineering goals? I have not been able to find any mention of who the designer was, nor any mention even whether his identity is lost to history.

An Opening Repertoire for Whom?

The icons used in almost all modern chess diagrams were introduced around 1800. Historians have written that Nathaniel Cook engineered the Staunton design of the wooden chess pieces in 1849, but I cannot find a word about who designed the chess diagram icons decades earlier. In practice the icons used by various publishers do differ a little among themselves, but they are similar enough to each other that we think of them as all being the same icon.

The icons for all the pieces were not engineered to be easily perceivable to the human visual system after they are rotated 180 degrees. Thus traditional diagrams can be studied only from White's perspective, even when it is Black's move. Occasionally this is a minor inconvenience or annoyance. In a couple of situations this diagram perspective limitation can be a genuine issue.

Consider the case of any chess book dedicated to an opening repertoire for Black. As just one instance, in 2001 Gambit published a book by Jouni Yrjola and Jussi Tella entitled *An*

Explosive Chess Opening Repertoire for Black. The book contains 334 diagrams (about 55 pages worth of space). The Yrjola book is for players who want to learn how to open when playing with the Black pieces. The book's introduction begins "Our main objective is to give *Black* a complete repertoire with the opening move 1... d6" (italics added). Obviously during tournament games, those players with Black who attempt to apply what they learned from this book will never be viewing the position from the White perspective. They will view the piece patterns only from Black's perspective. So why do all 334 diagrams show the piece patterns from only White's perspective??

Maybe it was done with the idea that it would seem unprofessional to show diagrams from Black's perspective, regardless of the logical dissonance involved: in other words they were "tradition whipped". Or maybe the idea was to maintain a reliable look and feel across all Gambit books to strengthen the brand name. Or maybe the whole issue never occurred to either the authors or the publisher, because the convention of row 1 at bottom is so highly pervasive it is unthinkingly taken for granted? Or maybe grandmaster authors mistakenly think the orientation does not matter to club players because it does not matter to them?

Only Masters Need Apply: In *Chess Life* of 2003/08, in discussing diagrams columnist Larry Evans wrote that "...it's harder for beginners to visualize the board from Black's point of view." If Mr. Evans meant most beginners, then we might also say some intermediate players also find it harder, and a few expert players might too. This adds to the argument that the diagram presentation choice made for the Yrjola book may not have been the best.

Fritz and Arena and all other similar chess software offer a toolbar button that flips the board perspective between row 1 or row 8 at the bottom. I have clicked this button lots of times, and I am confident there are others who have too. I almost always click it when I want to study an opening I might play as Black. These actions are direct indications that readers of the Yrjola book might

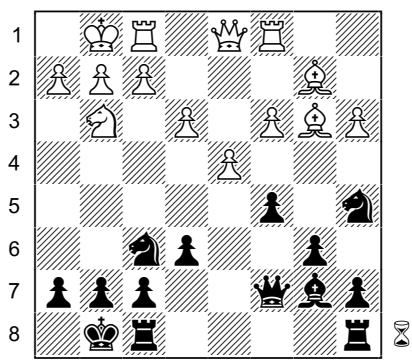
also have wished they could flip the diagrams to Black's perspective.

I have used the Yrjola book only as an example to facilitate explanation of my thoughts on this topic. I mentioned Larry Evans' comments only for the same reason. I think highly of both Gambit and of Mr. Evans, and I could just as easily have chosen from among any number of other equivalent examples.

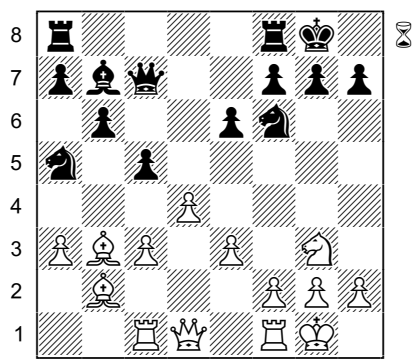
Have there been any solutions proposed for the problem of diagrams being viewable from only White's perspective? Oh yes.

Less Rigid Publishing Conventions

For the Yrjola book the simplest solution would have been to construct the diagrams with row 8 at the bottom. The chess diagram fonts are just as easy to use in either case. I believe the diagram below at left, built with row 8 at the bottom, is just as easy to study as its counterpart on the right.



D.Rivera – R.Fischer, Varna 1962.
After 13... Bc8b7 14. Ra1c??
Next 14... Qc76 15. f23 Qc6b5
16. Bb3a4 Qb5:B2, 0-1



(Same position, diagram built for viewing from White's perspective.)

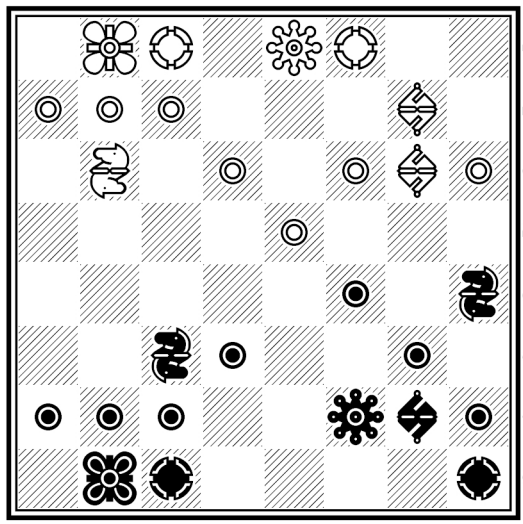
The ideal might have been if the icons had been originally engineered in 1800 to be rotatable, meaning easily perceivable in either 180 degree rotation orientation. Below we look at two ways an icon engineer might achieve this kind of rotate-ability for his icons.

Chess Montreal: Rotatable by Symmetry

Gary Katch created a clever approach to solving the diagram perspective problem. Noting that all physical chess pieces are round in the cylindrical sense (except the knight), Katch's initial insight was the idea that each icon could be drawn to match how the top of each real piece looks when it is viewed from well above the real board. Such drawings could be made to have 180 degree rotational symmetry. This means each icon would look identical to itself after the diagram was spun around to the perspective of the other color.

Katch manufactured a font based on this idea of symmetry. He named it Chess Montreal (see EnPassant.dk, used here by permission). The knights were forced to stray from the view-from-above approach, so Katch made the knight two-headed to maintain perfect symmetry. Katch used this same two-headed decision for the bishops, but why? My educated guess is that he saw a lot of circles on Chess Montreal diagrams, and decided the bishop needed to be more distinctive. To me eyes the two-headed icons look a little too cramped, but that is only a small concern.

Below is the same Rivera-Fischer diagram in Chess Montreal. Clearly all of the piece icons in this diagram would look exactly the same as they do now if the diagram were rotated 180 degrees. Everything else being equal, that is a great feature. However, not everything else is equal.



D.Rivera – R.Fischer, Varna 1962.
In Chess Montreal.

Judgment about the desirability of any given diagram design will always comes down to personal taste. But to me the Chess Montreal icons as a group feature a bit too much roundness. To my eyes this causes each individual icon to lack sufficient distinctiveness. I have to look directly at each to easily understand which piece it represents. My peripheral vision cannot quite grasp them as easily. I think the excessive roundness is a natural risk when ever 180 degree symmetry is a requirement.

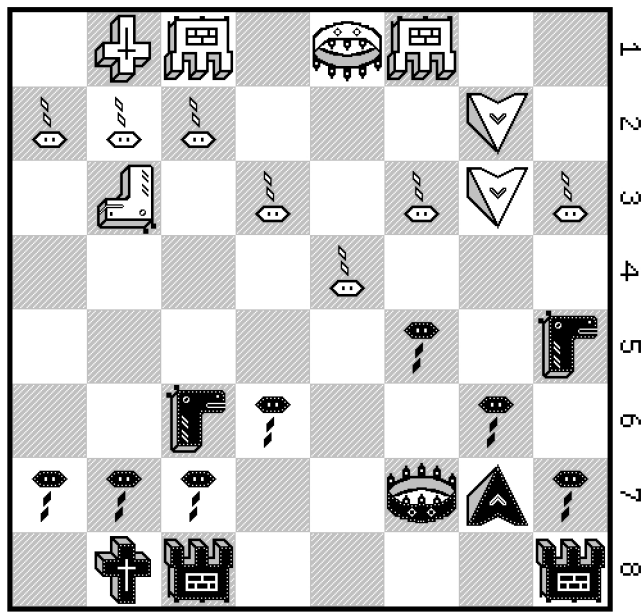
Nonetheless I admire Chess Montreal.

Handy Symmato: Rotatable by Simplicity

A second strategy for making chess diagram icons easy to perceive even when they are rotated is to make each icon of simple and pure design. For instance, a triangle is such a simple and pure shape that you dear reader have no difficulty identifying one regardless of its rotational orientation, anywhere

from 0 to 360 degrees. The same is true for a cross, and a right angle, and an oval, and a square, and a circle with a stick. Happily there are just enough shapes that are simple and pure that are nonetheless clearly different from each other.

I created Handy Symmato (HSym) from this philosophy of simple and pure shapes. Below is an HSym version of the same Rivera-Fischer diagram.



Handy Symmato 3D.
D.Rivera – R.Fischer, Varna 1962.
After 13... Bc8b7 14. Ra1c??
Next 14... Qc76 15. f23 Qc6b5 16. Bb3a4 Qb5:B2 0-1

A Cross is Still a Cross: The main idea is that the two armies of icons can be in different 180 degree rotational orientations. This is acceptable because HSym icons are engineered to be easier to perceive when "upside-down" than are the traditional icons. When you look now at the upside-down White king in the above diagram, is any effort needed to see that

it is a cross? Is the triangular essence of the White bishops still obvious? Does the White knight still look like a right angle (in the proportion of a knight's move)? Do the White rooks still look square-ish, and are its battlements still obvious. Does the White queen still look oval or circular? To me the answers are all yes. There is no doubt which icons are the White pawns either.

The separate 180 degree rotational orientations of the two armies means the diagram is equally viewable regardless of whether row 1 or row 8 is at the bottom.

Traditional Icons are Complex: The traditional chess icons may not seem complex but in a sense they are. Imagine you had to verbally instruct someone to draw all the traditional icons. The listener has never seen them, and you cannot see what he is drawing. The drawings he would produce might not look much like the traditional icons. Now for HSym I could call out instructions like...

> "Draw a plus sign but make the bottom line a little longer. Draw a stick man with neither arms nor legs, and make sure his neck does not quite reach his head. Draw a triangle. Draw an oval that is wider than it is tall." (and so on)

Another reason the traditional icons are hard to perceive upside-down is that they all share the same long flat base. When rotated to the top these non-descript edges become the main point of focus for the human eye. Thus all the upside-down icons tend to look similar.

3D: The first HSym icons I drew were 2D (two dimensional). After looking at them for a day I realized their simplicity made it possible to give them a vivid 3D look, as an option. There are a couple of 3D hints in the traditional icons, but they are noticeable only when looking for them up close. To me the strong 3D effect gives a diagram more life. Another benefit of

the 3D icons is that they are more easily seen through the clutter of the numerous pawns, because the pawns purposely lack 3D cues.

Pawn Color to Movement Ratio Made to Match: The pawns are the only chess pieces with movement restricted in any uni-directional sense. The White and Black pawns have opposite uni-directional movement. Yet in diagrams their drawn orientations are the same. This creates a color-to-movement ratio discrepancy that occasionally leads to brief confusion. It seems more natural for each color pawn to be shown in an orientation harmonious with its uni-directional movement.

Draw by Hand: The simplicity of the HSym 2D icons makes them easy to draw by hand, even for someone like me who has zero artistic or drawing skill. Using HSym 2D, I started hand drawing the crucial position for each of my tournament games in the blank diagram printed on the score sheets of my booklet. Now I can flip to most any game and recognize the game quickly by looking at the diagram.

Finally, Full Context Independence for CRAN: Eventually I became able to draw the HSym icons so quickly that I wrote my own form of Figurine Concise Reversible Algebraic Notation (FCRAN) during my tournament games (though I would not recommend others draw icons). To avoid mistakes more than by RAN alone, I even drew the icons for Black pieces upside-down. This way of drawing figurines, when combined with CRAN, finally makes each ply fully independent of all context. Now when I write variations in the cramped margins of my scorebook, I dispense with the move numbers and the "..." that often precedes a first Black move.

Shogi is an Odd Hybrid

Shogi is a game with many similarities to chess. Shogi is more popular in Japan than is chess. One day I happened to look at a shogi diagram and was pleased to see the icons of its two armies were rotated 180 degrees different from each other, just as in HSym. This shows the major idea underlying HSym is sound.

Given the shogi icons are rotated, it is odd that the shogi icons themselves are very complex to an untrained eye like mine. The vast majority of shogi diagrams use what look like Kanji characters (not quite 'letters') from the Japanese language. These same icons are used in real shogi play on a board, the icons being printed on to domino-like tiles. A trained eye can instantly notice that two icons are the same even when they are far apart. For me with an untrained eye, the shogi icons are so difficult to perceive that I would have to look back and forth a few times just to determine that two tiles bear the same icon.

Diagram for the Blind?

This section heading sounds like an oxymoron. I am not referring to brail or anything similar, I am referring to standard black ink on white paper. In the news headlines of medical science the past few years there have been blind individuals who have had a very limited form of sight restored, by electrified implants nestled into the visual cortex of their brain. These implants are fed by arrays of light sensors mounted on frames that can look like bulky eye glasses (or directly from a computer).

The first person to have this implant is discussed by his first name Jens. The implant Jens received gives him 70 pixels of vision. These are monochromatic, and they are binary (fully on or off). Though the implant's electrodes are arranged in a perfect rectangular grid, it is not necessarily the case that Jens perceives the pixels to be in that same exact arrangement. Yet these pixels do give Jens enough vision to sometimes determine when he might be walking into an object like a tree. 70 pixels is not many,

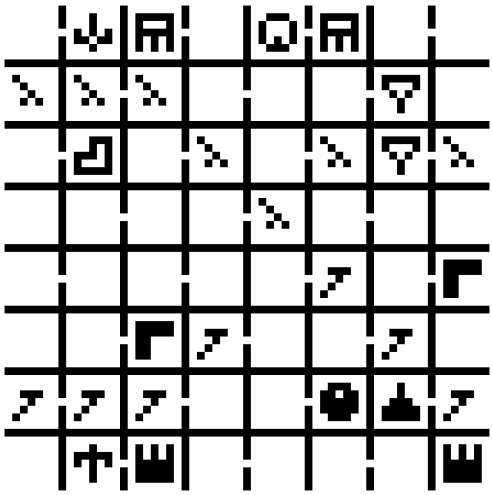
but I presume technology will improve. Who knows, perhaps around the year 2090 the pixel range might be in the low thousands.

Spurred by the story of Jens, I wondered what was the minimum number of pixels necessary to create a true chess diagram. The idea is that visual implants might enable otherwise blind people to see a bare bones efficient chess diagram (instead of a full 3D chess board) when trying to play chess.

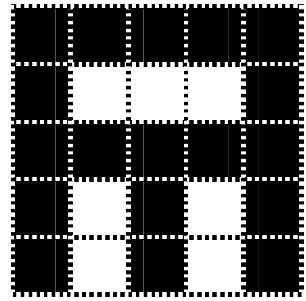
The design I came up with requires 3721 binary pixels. I cannot see how to reduce the number any further, given the following requirements. But I would be interested to hear from anyone who can engineer a way to accomplish this in even fewer pixels.

One requirement is that the piece icons be genuine shapes, not arbitrary dot patterns like brail letters. Another requirement is that the White and Black pieces must look different from each other. Another requirement is that the diagram must indicate each individual square, and signify which are light versus dark squares. It is too hard to comprehend the position with just open space lacking the structure of squares. Another requirement is that the diagram can use only black ink on a white background, no gray and no colors.

To meet these requirements I needed very simple shapes. The idea of icons modified from the traditional icons is totally unworkable. But when I tried to simplify the already simple HSym 2D icons, I found they reduced extremely well. Below is an HSym diagram for a future blind who has been given limited sight by an implant, one providing at least 3721 pixels. Each piece icon is encoded by a 5x5 grid of adjacent squares (as with MsPaint.exe).



D.Rivera – R.Fischer, Varna 1962.
In Handy Symmato Blind. 3721 pixels.
The cornered Black rook is on light square a8.
Are fewer binary pixels possible?



A 5x5 grid showing a rotated White rook (not Black), in HSym Blind.

The individual squares are demarcated by a grid. Every second vertical grid segment has a white pixel embedded at its midpoint. In all cases, the square on the 'a' side of the embedded white pixel is a dark square, and a light square is on the 'h' side.

The 5x5 grid per piece is very limiting, and better icons could be produced with 6x6. But that would increase the total pixel count to 4761. Impressively, even at a mere 5x5 the same HSym essence can be understood in most or all of the icons.

The Tyranny of Transition

Measurement of merit is not the only criterion needing consideration when choosing a chess figurine notation or diagram icons. Descriptive notation was used in most American chess books and magazines for decades after the rest of the world had

realized the superiority of algebraic. I have shelves full of chess books marred by the delay in switching to algebraic. Why did it take so long to switch? The biggest obstacle was that most USCF members felt Descriptive notation was better, probably because that is what they were born into rather than due to any objective assessment of merit (that is human nature).

Another reason for the delay in switching to algebraic notation was probably concern over having to endure a transition period. In the case of notation this was not a huge problem, especially since computer notation protocols like PGN had not yet complicated the scene.

Any idea of switching chess diagram icons would involve an enormous transition period. Unless the current icon set was causing a major problem it would be hopeless to suggest a general switch in icons to the chess playing public.

In contrast, for chess960 there is no significant issue of a transition period, beyond matters of personal taste. Chess960 is just chess once the pieces start moving.

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