

Chess and Systemology

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INTRODUCTION

Chess players from beginners to grandmasters often notice strong similarities between chess and real life (e.g., Kasparov and Greengard. 2007). Even Benjamin Franklin once wrote that “life is a kind of chess” (Alburt and Lawrence 2008, p. 3). This similarity should not be surprising since chess is an idealized and abstracted version of a real battle with real warriors. More generally, chess is a complex system (“Complex system.”) that involves sets of moving objects that interact with each other in nearly physical ways that resemble real life much more than purely abstract systems like mathematics or logic. As a result of this similarity and of the presence of emergence in chess (“Emergence.”), people can learn valuable lessons about life from chess, which implies chess is a useful system to study for general wisdom about life, not only as a game.

The principles common to real life and chess are numerous but until recently have not been well documented, especially in the form of a substantial list. This document contains the beginning such a list, where each principle is a piece of wisdom supported by specific examples from chess and other complex systems. One potentially valuable use of such a collection of wisdom is that it could form the foundation of a new science of wisdom (“synesology”?) to help compress information in our world of information overload where we must currently resort to data mining (e.g., Zaiane 1999) in an attempt to summarize all that information into useful knowledge, which is the next level of data abstraction (“DIKW pyramid.”). More generally, there has been little interest in a nascent field regarding common emergent behavior of complex systems work, a field called “systemology” (e.g., Centre for Systems Philosophy 2015; “Systemology.”), so possibly a document such as this one could tie synesology with systemology, or could suggest a good organizational structure for future efforts to develop these two fields.

This document is organized with an equal number of examples for chess and other systems, with the set of chess examples given first for each given principle. All chess principles listed have been observed by the author in at least two games, usually many games. Although there is considerable overlap between all the systems of real life that makes a natural organization problematic, a few systems such as Warfare have so much overlap with chess that the document was first roughly subdivided into chapters by those large, obvious groups. The “Other Systems” chapter is the miscellaneous chapter at the end that contains the the bulk of principles. The general chapters of this document are therefore:

T. TIME

T1-T2

W. WARFARE

W1-W12

R. REPRESENTATION

R1

Y. PSYCHOLOGY

Y1-Y2

S. OTHER SYSTEMS

S1-S13

Within these general sections, specific non-chess examples are taken from the following fields, which are hierarchical as shown:

animal competition

 animal behavior

 hunting

arts

 music

 photography

astronomy

aviation

biology

 botany

business

chemistry

cognitive science

computer science

criminology

ecology

engineering

everyday life

geology

martial arts

mathematics

medicine

natural language

physics

politics

psychology

religion

sociology

sports

 games

warfare

T. TIME

Principle T1:

An action that does multiple good things at once is usually the best choice of actions.

EXAMPLES FROM CHESS

(1) The popularity of 2. Nf3 in the Double King's Pawn Game

If one compares the relative popularity of White's various second moves in the Double King's Pawn Game, one can see that a move's popularity increases roughly as the count of good things each move accomplishes increases. By far the highest count of accomplishments among the shown choices comes from the move 2. Nf3, which not coincidentally is the most popular move (“#1 pop”) for White in that position.

1. e4 e5 {Double King's Pawn Game.}

The most popular responses are:

2. Nf3 {#1 pop.}

Benefits: (1) Develops. (2) Develops knights before bishops. (3) Controls the center. (4) Prepares for castling. (5) Threatens an opponent's unit.

Total number of benefits: 5

2. Nc3 {Vienna Game. #2 pop.}

Benefits: (1) Develops. (2) Develops knights before bishops. (3) Controls the center.

Total number of benefits: 3

2. f4 {King's Gambit. #3 pop.}

Benefits: (1) Controls the center.

Total number of benefits: 1

2. Bc4 {Bishop's Opening. #4 pop.}

Benefits: (1) Develops. (2) Controls the center. (3) Prepares for castling.

Total number of benefits: 3

2. d4 {#5 pop.}

Benefits: (1) Controls the center. (2) Frees a piece. (3) Threatens an opponent's unit.

Total number of benefits: 3

(1) Moves that are both defense and offense

In many well-known chess openings, which have often been studied in depth for centuries, the moves that have been eventually become regarded as optimal are those that combine both defense and offense. This is particularly true of a piece that must flee to avoid capture, but upon its flight also creates an immediate threat. This new threat can be a threat on its former attacker, or a threat elsewhere.

1. e4 c6 {Caro-Kann Defense.}
2. d4 d5
3. Nc3 dxe4
4. Nxe4 Bf5 {Classical Variation. (Figure T1.1)}
5. Ng3 {(Figure T1.2)}



Figure T1.1. The bishop threatens the knight.



Figure T1.1. The knight flees and threatens the bishop.

EXAMPLES FROM OTHER SYSTEMS

(1) Trip planning [everyday life]

Here is a typical choice when making a local excursion:

- Option #1: Travel directly to your destination, but you will need to buy expensive food while there.
 Option #2: Travel somewhat out of the way to get inexpensive food first, buy an additional desired item there from a nearby store, then travel to your destination.

Each option has one bad attribute (price or distance), but since Option #1 does one good thing (saves time) and Option #2 does two good things (saves money, and allows purchase of another desired item), Option #2 is likely the best choice, excluding any unexpectedly severe costs or conditions along the way.

(2) Pros and Cons list [everyday life]

Benjamin Franklin used a list of pros and cons of a situation in order to make a wise decision on an issue. As a first approximation a mere count of pros and cons can be used, especially after striking through pairs of pros and cons that exactly balance each other out. Ideally, however, importance measures and weights should also be used in mathematical combination for higher accuracy. (McKay and McKay 2009)



Principle T2:

Proper timing is sometimes the one thing that makes all the difference.

EXAMPLES FROM CHESS

(1) Moves in the Sicilian Defense

Timing is critical all throughout the double-edged Sicilian Defense. Even as early as the fourth move, the right move played by Black at the wrong time can allow White to gain an unnecessarily strong position.

In particular, the first few opening moves for the Sicilian Defense are commonly:

1. e4 c5 {Sicilian Defense.}
2. Nf3 d6
3. d4 cxd4
4. Nxd4

Some of the moves Black would like to play next are:

...Nf6
...Nc6
...a6

The standard next fourth move is 4...Nf6, but sometimes an unknowledgeable player will play 4...a6 first. This move order makes a significant difference because 4...Nf6 would attack White's e4-pawn, which in turn would force White to protect it, typically with 5. Nc3, before doing anything else. In contrast, 4...a6 contains no immediate threat, it does not develop a piece, and it does not even directly challenge the center, therefore White is free to continue exerting pressure on the center, and a strong move that will do this is 5. c4. This leads to a formation called the Maroczy Bind, which is an unusually strong center for White. Nowadays, although the Maroczy Bind is not as feared as it used to be, it still gives White a stronger center than he needs to have. Tracing this back, it can be seen that the suboptimal move 4...a6 allowed White to advance his c-pawn before blocking it with his knight, which is an ideal situation for White (also seen in the Queen's Gambit). Had Black played the standard, recommended move 4...Nf6 first, White would have been pressured to block his c-pawn with his knight via 5. Nc3, which would have constrained his control of the center slightly. In this case move order makes a difference.

EXAMPLES FROM OTHER SYSTEMS

(1) **Karate** [martial arts]

Split second timing is critical in karate. There exists a very brief moment--a state called Kyo--when the opponent is not in perfect posture, stance, emotions, and spirit, therefore cannot successfully defend himself at that moment, which is the ideal time to strike at him. The time span of this vulnerable period is so short that there is not enough time to consciously think about it, which means such a blow must be initiated by reflex actions, perfected by much practice. (Rokah 2011)

W. WARFARE

Principle W1:

Sometimes you can use your opponent's body/bodies for shelter.

EXAMPLES FROM CHESS

(1) **A king walk to shelter**

In the following game (ebillgo 2016) it appears as if White's invasion and long sequence of checks will soon be fatal, but Black realizes that this is an unusual position where the black king can find shelter among enemy pawns instead of the usual shelter among his own pawns. Once that shelter is reached, White's attack abruptly ends, whereupon Black's counterattack is fatal.

1. d4 Nf6
2. c4 g6 {King's Indian Defense.}
3. g3 Bg7
4. Bg2 O-O
5. Nc3 Nc6
6. Nf3 d5
7. Ne5 dxc4
8. Nxc6 bxc6
9. Bxc6 Rb8
10. O-O Bb7
11. Bxb7 Rxb7
12. d5 Qd7
13. e4 c6
14. dxc6 Qxc6
15. Qe2 Nd7
16. Bf4 Ne5
17. Bxe5 Bxe5
18. Rac1 Rfb8
19. Nd5 e6
20. Rxc4 Qd7
21. Ne3 Rxb2
22. Rc2 Qa4
23. Rxb2 Rxb2
24. Qd3 Rb4
25. Rc1 Rxe4
26. Rc8+ Kg7 {(Figure W1.1)}
27. Qd8 Qb4
28. Qg8+ Kh6
29. Qxf7 Bd4
30. Rc7 Bxe3!
31. Qxh7+ Kg5
32. h4+ Kg4
33. Qxg6+ Kh3 {(Figure W1.2)}
34. Kf1 Qb1+
35. Ke2 Bb6+
36. Kd2 Rd4+
37. Kc3 Qb4+
38. Kc2 Rd2+
39. Kc1 Qb2# {Seliverstov Vladimir vs Savenkov
Konstantin. Ch Moscow, Moscow.}



Figure W1.1. The Black king begins its walk.



Figure W1.2. The Black king completes its walk.

(2) Hiding behind a single uncaptured pawn

One clever endgame trick, although not seen very often, is to refrain from capturing one of your opponent's pawns so that your king may hide behind it to escape from checks, especially if checked by a rook, which has less mobility than a queen.

In the following game (Chernev 1965, pp. 153-155), Réti as Black refrains from capturing White's e4-pawn in the endgame, which allows Black to use that pawn as a shield from checks along the e-file.

1. e4 c5 {Sicilian Defense.}
2. Nf3 Nf6 {Nimzovich-Rubinstein Variation.}
3. Nc3 d5
4. exd5 Nxd5
5. Bb5+ Bd7
6. Bxd7+ Qxd7
7. Nxd5 Qxd5
8. d4 e6
9. O-O Nc6
10. dxc5 Qxd1
11. Rd1 Bxc5
12. Bf4 Ke7
13. Ne5 Nxe5
14. Bxe5 f6
15. Bc3 Rhd8
16. Ba5 Rxd1+
17. Rxd1 Rc8
18. a4 Bd6
19. Rd2 Rc6
20. Bc3 e5
21. Rd3 Ke6
22. Rh3 h6
23. Rg3 g5
24. Rh3 Bf8
25. Rd3 Rc4!
26. b3 Rc6
27. f3 f5
28. g4 f4
29. Kf1 Bg7
30. Bb4 e4!
31. fxe4 Rxc2
32. Rd6+ Ke5
33. Rg6 Bf6
34. Rxh6 Bd8
35. Rh8 Bc7
36. h4 Kd4! {(Figure W1.3)}
37. hxg5 Ke3 {(Figure W1.4)}
38. Rh3+ f3
39. Ba3 Bd6!
40. b4 a5
41. Rh6 Bxb4
42. Bxb4 axb4
43. Kg1 b3
44. Rb6 b2
45. g6 Ke2!
46. g7 f2+
47. Kh2 f1=Q {0-1. Schalage vs R. Réti. Berlin 1928. Analysis:}
48. g8=Q Kf3#



Figure W1.3. Black leaves the e4-pawn standing.



Figure W1.4. The e4-pawn becomes a shield.

EXAMPLES FROM OTHER SYSTEMS

(1) Attacker as a shield [criminology]

Recall the scene from “Total Recall” (1990) where Quaid uses the body of the first attacker he shoots on the escalator as a shield while he shoots back at the gunmen following him up the escalator. Although this film is fictional, this principle of warfare holds in real life.



Escalator scene from “Total Recall” (1990).

(1) Hostage as a shield [criminology]

Any random person valuable to your opponent, even if not the enemy, can have their body used as a shield in a hostage situation.



Hostage scene from “The Untouchables” (1987).

Principle W2:

One strategy that works well is to keep your opponent busy in two places at once, preferably widely separated.

EXAMPLES FROM CHESS

(1) Switching an attack to the other side of the board

In chess a strategy that is sometimes used is to switch from a kingside attack to a queenside attack, or vice versa. Such switches can be done multiple times, although often just one switch is enough to be decisive if the position and timing are right.

In the following game (Chernev 1965, pp. 116-119) White switches his attack repeatedly between queenside and kingside, and eventually reaches an endgame where White can promote a pawn on either side of the board before Black can promote any of his pawns. Black's king cannot defend against the promotion threats on both sides at the same time, and is sadly relegated to shifting back and forth in the center, futilely trying to keep both sides covered at the same time.

1. d4 d5
2. c4 {Queen's Gambit.} c6 {Queen's Gambit Declined, Slav Defense}
3. Nc3 Nf6
4. Bg5 e6
5. Nf3 Bd6
6. e3 O-O
7. Bd3 Nbd7
8. O-O Re8
9. Qc2 Qc7
10. c5! Be7
11. Bf4 Qd8
12. b4 Nf8
13. h3 Bd7
14. b5 {Attack on queenside. (**Figure W2.1**)} Qc8
15. a4 Nh5
16. Bh2 Bd8
17. a5 Bc7
18. Bxc7 Qxc7
19. a6! b6
20. bxc6 Bxc6
21. cxb6 Qxb6
22. Rfb1 Qd8
23. Ne5 Bd7
24. Nxd7 Nxd7



Figure W2.1. Attack on queenside.



Figure W2.2. Attack shifts to kingside.

25. Bxh7+! {Attack on kingside. (Figure W2.2)} Kh8
 26. Bd3 Nb6
 27. Na4 {Attack on queenside. (Figure W2.3)} Nxa4
 28. Qxa4 Re7
 29. Rb7! Rc8
 30. Rab1 Rec7
 31. Qa5 g6
 32. Bf1 Nf6
 33. Rxc7 Qxc7
 34. Qxc7 Rxc7
 35. Rb7 Rxb7
 36. axb7 Nd7
 37. Bb5 Nb8
 38. h4! {Attack on kingside.} Kg7
 39. g4 Kf6
 40. f4 Ke7
 41. Kf2 Kd8
 42. Ke2 Ke7
 43. Kd3 Kd6
 44. Kc3 f6
 45. Kb4 {Attack on queenside.} e5
 46. dxe5+ fxe5
 47. fxe5+ Kxe5
 48. Kc5 Ke6
 49. h5 {1-0. S. Tarrasch et al. vs J. Mieses et al. Leipzig
 1888. Analysis: Attack on kingside.} gxh5
 50. gxh5 Kf6
 51. Kd6 {Attack on queenside.} a6
 52. Kc7 axb5
 53. Kxb8 b4
 54. Kc7 b3
 55. b8=Q



Figure W2.3. Attack shifts to queenside.

EXAMPLES FROM OTHER SYSTEMS

(1) Hitting crosscourt in tennis [sports]

In tennis a basic strategy is to hit the ball “crosscourt,” meaning at an angle to cause the ball to land in the extreme opposite corner of the court on the opponent's side. One reason this works so well is it forces the opponent to work harder because he must run the farthest possible distance across the court to intercept the ball in time, and there is a greater likelihood of winning whenever your opponent is struggling. (Westermann 2015)



Principle W3:

It is dangerous to get trapped in a corridor, especially one with no outlet.

EXAMPLES FROM CHESS

(1) Corridor mates

A common type of checkmate is the corridor mate, most commonly in the form of the bank rank mate. A corridor mate is where the king is blocked by his own units that form a wall alongside of him, thereby preventing the king from escaping from that corridor in a single move, which is therefore checkmate if the king is in check. The edge of the board usually forms the other side of the corridor. The following amateur game (checkmateibeatu 2011) contains a bank rank mate that was simply overlooked by White.

1. Nf3 {Zukertort Opening.} Nf6
2. d4 d5 {Queen's Pawn Game.}
3. Nc3 e6
4. Bf4 Bb4
5. Qd2 Ne4
6. Qe3 O-O
7. a3 Nxc3
8. bxc3 Be7
9. Bh6 b6
10. Qe5 Bf6
11. Qg3 Bb7
12. Rb1 Re8
13. e3 g6
14. Ne5 Nd7
15. Bb5 Nxe5
16. Bxe8 Qxe8
17. dxe5 Bg7
18. Bxg7 Kxg7
19. Qf4 Kg8
20. Qf6 Qc6
21. O-O Qxc3
22. Rb4 Qxa3
23. Rf4 Rf8
24. Rd1 Qc3
25. Rdd4?? Qe1# {checkmateibeatu (1200) vs bobthepotato (1500). Live Chess 4 0 | Chess.com | 19 Jul 2011 | 0-1. (Figure W3.1)}



Figure W3.1. Back rank mate.

EXAMPLES FROM OTHER SYSTEMS

(1) Crime in cul-de-sacs [criminology]

Statistically, residential cul-de-sacs tend to have less crime (Whittaker 2013), presumably because criminals prefer to conduct their illegal activities in locations where there exist more avenues of escape in the event if they need to flee in a hurry.



Principle W4:

One powerful strategy in suitable situations is to flush your prey into the open where your forces are waiting.

EXAMPLES FROM CHESS

(1) Flushing out the king

A common type of mating attack is to flush the enemy king out into the open, especially when it is driven against one of your pawn phalanxes. This often requires looking 5-10 moves ahead to make certain that mate will occur, but mate does occur in nearly all such cases.

In the following opening trap this scenario happens more quickly than usual. (Pandolfini 1989, p. 21)

1. e4 e5
2. Nf3 Nc6
3. d4 {Scotch Opening.} exd4
4. Bc4 {Scotch Gambit.} Na5?
5. Bxf7+ {(Figure W4.1)} Kxf7
6. Ne5+ Ke6
7. Qxd4 Nc6?
8. Qd5+ Kf6
9. Qf7+ Kxe5
10. Bf4+ Kxe4
11. Nc3+ Kd4
12. Qd5# {(Figure W4.2)}



Figure W4.1. Black's king is flushed out.

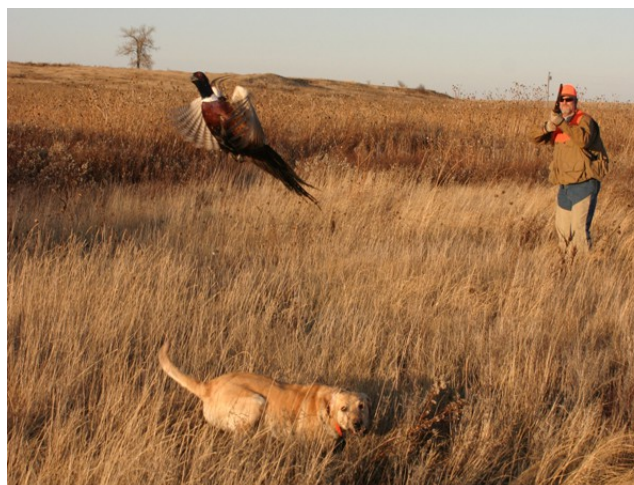


Figure W4.2. Black's king is mated in the open.

EXAMPLES FROM OTHER SYSTEMS

(1) Pheasant hunting [hunting]

Flushing dogs are used by hunters to flush pheasants out of the brush and into the air, where nearby hunters with shotguns can see the birds and get a clear shot at them. ("Flushing dog.")



Principle W5:

Optimal placement of any force or weapon is usually near the center and surrounded by open space so as to reach as many potential targets as possible, and with the closest range possible.

EXAMPLES FROM CHESS

(1) Centralized queen on an open board

A powerful move sometimes seen in the middlegame when the board has largely cleared is to move the queen to a square near the center. This move is often subtle and can have a big influence even on the 3rd rank or 2nd rank, depending on the position. Even if that queen does not have any immediate threats, it can often influence both sides of the board at the same time, create pins, pick off the enemy's pawns, or invade behind enemy lines with relative ease. Such queen moves were one of Bobby Fischer's trademarks.

In the following game (Chernev 1965, pp. 61-63) White plays such a move at move 22, with the effect of pinning Black's g7-pawn and simultaneously protecting White's c5-pawn, which in turn allows White to advance his b-pawn.

1. d4 Nf6
2. c4 e6
3. Nc3 Bb4 {Nimzo-Indian Defense.}
4. e3 c5
5. Ne2 cxd4
6. exd4 d5
7. c5 Ne4
8. Bd2! Nxd2
9. Qxd2 b6
10. a3 Bxc3
11. Nxc3 bxc5
12. dxc5 a5
13. Bb5+ Bd7
14. O-O O-O
15. b4 Bxb5
16. Nxb5 Na6
17. Nd6 Qd7
18. f4! Rab8
19. f5 exf5
20. Rab1 axb4
21. axb4 Kh8
22. Qc3! {(Figure W5.1)} Nc7
23. Nxf5 Ne7
24. Nd6 f6
25. Qh3! Rfd8
26. Rfe1 Nd4



Figure W5.1. White's queen becomes centralized.

27. Re8+! Qxe8
28. Nxe8 Rxe8
29. b5! Nxb5
30. Qd7 Nc3
31. Rxb8 Rxb8
32. c6 Ne4
33. h4 {1-0. S. Reshevsky vs M. Najdorf. Dallas
1957.}

EXAMPLES FROM OTHER SYSTEMS

(1) Candlelight / good works [religion]

The Bible mentions not setting a candle under a bushel, but rather on top of the bushel, so as to cast as much light around it as possible, as an analogy to letting one's good works be visible to everyone. (“Lamp under a bushel.”)



Principle W6:

If possible, in warfare one should disguise one's hostile intentions.

EXAMPLES FROM CHESS

(1) Indirect transposition to a desired opening

In modern times it has become fashionable for a player to disguise his intentions for the opening he wants to play by transposing to that opening from a less common sequence of moves.

In the following game (Harding and Barden 1976, pp. 11-12), Karpov as White starts out noncommittally with 1. Nf3, and only on his third move does he transpose to his desired opening: the Queen's Gambit. Although this sneaky transposition probably did not affect the final outcome of the

game, he did happen to win in this case.

1. Nf3 {Zukertort Opening. (Figure W6.1)} d5
2. d4 Nf6
3. c4 {Queen's Gambit. (Figure W6.2)} e6
{Queen's Gambit Declined.}
4. Nc3 Be7
5. Bg5 h6
6. Bxf6 Bxf6
7. e3 O-O
8. Qc2 c5
9. dxc5 dxc4
10. Bxc4 Qa5
11. O-O Bxc3
12. Qxc3 Qxc3
13. bxc3 Nd7
14. c6 bxc6
15. Rab1 Nb6
16. Be2 c5
17. Rfc1 Bb7!?
18. Kf1 Bd5?
19. Rb5! Nd7
20. Ra5 Rfb8
21. c4 Bc6
22. Ne1! Rb4
23. Bd1! Rb7
24. f3 Rd8
25. Nd3 g5
26. Bb3! Kf8
27. Nxc5 Nxc5
28. Rxc5 Rd6
29. Ke2 Ke7
30. Rd1 Rxd1
31. Kxd1 Kd6
32. Ra5 f5
33. Ke2 h5
34. e4 fxe4
35. fxe4 Bxe4
36. Rxc5 Bf5
37. Ke3 h4
38. Kd4 e5+
39. Kc3 Bb1
40. a3 Re7
41. Rg4!?! h3
42. g3 Re8
43. Rg7 Rf8
44. Rxa7 Rf2
45. Kb4 Rxh2?



Figure W6.1. White begins noncommittally.



Figure W6.2. White indirectly reaches his goal.

46. c5+ Kc6
 47. Ba4+ Kd5
 48. Rd7+ Ke4
 49. c6 Rb2+
 50. Ka5 Rb8
 51. c7 Rc8
 52. Kb6 Ke3
 53. Bc6 h2
 54. g4 Rh8
 55. Rd1 Ba2
 56. Re1+ Kf4
 57. Re4+ Kg3
 58. Rxe5 Kxg4
 59. Re2 {1-0. Karpov-Kasparov, 27th match game,
 Moscow 1984. {(Figure W6.3)}



Figure W6.3. White wins.

EXAMPLES FROM OTHER SYSTEMS

(1) Fish stripes over eyes [animal behavior]

Just as with humans can often discern intentions by looking into each other's eyes, fish seem to be able to do the same, since some fish evolved a mechanism whereby a dark stripe appears across their head and eyes when they intend to eat another fish.

Principle W7:

Morals aside, a universal strategy is to attack the weakest members of an enemy's population.

EXAMPLES FROM CHESS

(1) Attacking an isolated pawn

A well-known chess strategy, especially in d4-pawn openings, is to create an isolated d-pawn, then to gang up on it with pieces, since such a pawn cannot be protected by neighboring pawns as is usually the case. If that pawn is won then the materially superior side is likely to have a winning game since the extra pawn can usually be promoted to a queen.

(2) Attacking a backward pawn

Another well-known chess strategy is to attack a backward pawn, since such pawns tend to be weak since they require protection from pieces instead of from the usual, low-value, neighboring pawns.

EXAMPLES FROM OTHER SYSTEMS

(1) Wolves [animal behavior]

Wolves select the weakest members of their prey to attack. The weak members they look for are the young, old, sick, wounded, or those isolated from the herd. (Defenders of Wildlife)

(1) Soccer [sports]

One soccer strategy is to detect, the identify, then attack those weaknesses in your opponent. (Soccer-Training-Methods.com)

Principle W8:

Morals aside, it is disadvantageous to burden your own forces with protection duties instead of battle duties.

EXAMPLES FROM CHESS

(1) A pieced tied to the defense of a pawn

A common weakness in a chess position is to have a piece being used only to defend a pawn, which has much lower value. Pieces have more important work to do than to prevent minor losses of material, which is why an isolated pawn can be a liability: no neighboring pawn of the same value can protect that isolated pawn, so a piece must do that work.

EXAMPLES FROM OTHER SYSTEMS

(1) .223 ammunition [warfare]

The .223 full metal jacket round from the M-16 rifle has been demonized by the mainstream media as being too deadly for civilian use, but that round was never even intended as a killing round, only as a wounding round, even for the military. Per the Hague Convention and Geneva Convention it is illegal for military forces to deliberately kill, such as with more efficient hollow point rounds or larger calibers, so the less lethal .223 round was made a standard round for the United States military. The reasoning for using an underpowered round was that a dead soldier can be ignored on the battlefield, which costs nothing, but a wounded soldier requires at least two men to carry him off the battlefield, another to treat him, and additional resources for transport and medical equipment, which incurs much higher costs to the side burdened with the injured soldier. (militiaact 2013) Morals aside, in general the side that relegates its strong (uninjured) soldiers to attending to the weak (injured) soldiers suffers a strategic loss.



.223 ammunition was designed to injure, not kill.

Principle W9:

Gaining control of the center is highly advantageous, especially in board games, even when there exists no three-dimensional height advantage to the center.

EXAMPLES FROM CHESS

(1) Ideal opening position

An ideal opening position for either side in chess is where all pieces developed and are aimed at the center, with the king tucked safely off to one side. The exact ideal position varies by opinion, but it is almost always close to the following position:



An ideal opening position, one that controls the center.

(2) Centralized king in endgame

One wise and standard practice in most endgames is to move the king toward the center so as to be able to deploy the king the most easily to any location where it might be needed. A player who allows the opponent to do this, especially where there are locked pawn chains, usually loses. As the middlegame

begins to end and the endgame takes over, it is standard to see the kings begin to walk from their castled positions toward the center, often starting with Kf1 and ...Kf8 from where they have castled on the kingside.

The following game (Chernev 1965, pp. 242-246) shows Réti as Black walk his king to a centralized position in the endgame and then exchange rooks in a manner to first delay White's king from centralizing, then again to force White's to the edge. At that point, Black can take his choice of the side on which he wants to decimate White's pawns and win. Also note how both kings begin walking toward the center as the endgame approaches, in this case because of the threat of Black promoting his far advanced c-pawn.

1. e4 e6 {French Defense.}
2. d4 d5
3. Nc3 {Paulsen Variation.} Nf6
4. e5 {Steinitz Variation.} Nfd7
5. Qg4 {Gledhill Attack.} c5!
6. Nb5 cxd4!
7. Nf3 Nc6
8. Nd6+ Bxd6
9. Qxg7 Be5!
10. Nxe5 Qf6!
11. Qxf6 Nxf6
12. Bb5 Bd7
13. Nf3 Ne4
14. O-O f6
15. Bxc6 bxc6
16. Nxe4 c5
17. Ne2 Kf7 {(Figure W9.1)}
18. f3 Nd6
19. b3 e5
20. Ba3 Rac8
21. Rad1 d4
22. Nc1 Nf5
23. Rf2 Ne3
24. Re1 c4!
25. b4 Ba4!
26. Ree2 Nd1!
27. Rf1 Nc3
28. Ref2 Nb1!
29. Bb2 c3!
30. Nb3 Bxb3
31. axb3 Nd2
32. Re1 Rhd8!
33. Bc1 d3!
34. cxd3 Rxd3
35. Bxd2 Rxd2
36. Ra1 Ke6
37. Kf1 {White's king begins to centralize.}
- Rxf2+



Figure W9.1. Black's king begins to centralize.

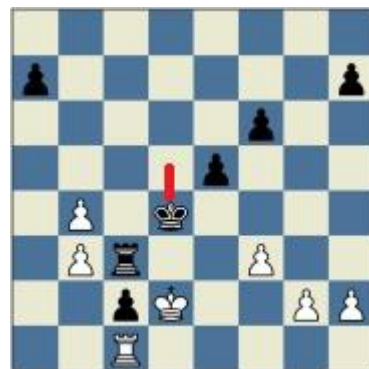


Figure W9.2. Black's king is maximally centralized.



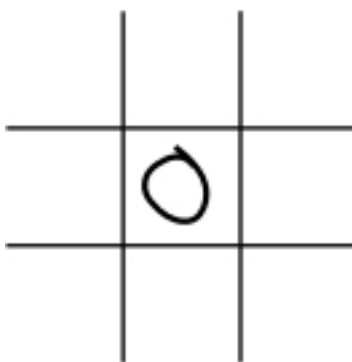
Figure W9.3. White's king is pulled to the edge.

- 38. Kxf2 {White's king has been delayed.} c7
- 39. Rc1 Kd5
- 40. Ke3 Rc3+!
- 41. Kd2 Kd4 {(Figure W9.2)}
- 42. h4 Rd3+ {0-1. E. Bogolyubov . R. Réti.
Mahrisch-Ostrau 1923. Analysis:}
- 43. Kxc2 Rc3+
- 44. Kd2 Rxc1
- 45. Kxc1 {(Figure W9.3)}

EXAMPLES FROM OTHER SYSTEMS

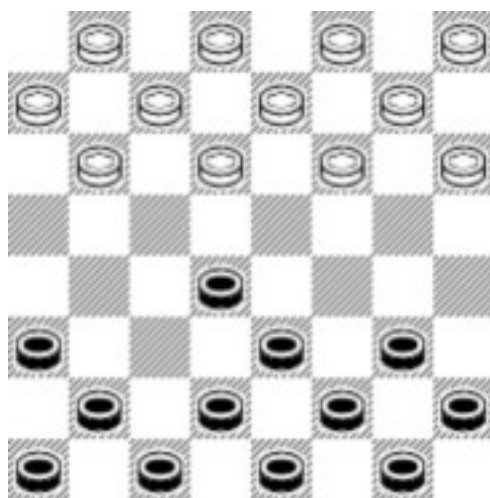
(1) Tic-tac-toe [games]

The standard and strongest starting move in tic-tac-toe is to mark the center square. (Chernev 1998, p. 29)



(1) Checkers [games]

The standard and strongest starting move in checkers is 11-15, which is into center. (Chernev 1998, p. 29)



The standard starting move in checkers: 11-15.

Principle W10:

When an attack fails, whether because it is unsound or conducted poorly, the counterattack is usually fatal.

EXAMPLES FROM CHESS

(1) Failed attack in opening

In the following game (Fischer 1972, pp. 338-342), Black starts out with what appears to be a surprisingly deadly attack against White's exposed king in the opening. Defending as White, however, was grandmaster Bobby Fischer, who recognized that the attack was unsound, and he knew how to rebuff it properly. Suddenly Black's attack fizzles out, White begins to counterattack, and White quickly wins.

1. e4 c5 {Sicilian Defense.}
2. Nf3 d6
3. d4 cxd4
4. Nxd4 Nf6
5. Nc3 a6 {Najdorf Variation.}
6. Bc4 {Lipnitzky Attack.} e6
7. Bb3 Nbd7
8. f4! Nc5
9. f5! Nfxd4?
10. fxe6 Qa4+?
11. g3 Nxc3 {(Figure W10.1)}
12. Nf3! {(Figure W10.2)} Qh5
13. exf7+ Kd8
14. Rg1 Nf5
15. Nd5! Qxf7
16. Bg5+ Ke8
17. Qe2+! Be6
18. Nf4 Kd7
19. O-O-O Qe8
20. Bxe6+ Nxe6
21. Qe4! g6
22. Nxe6 {1-0.Fischer vs Bednarsky, Havana Olympic 1966. Analysis:} Qxe6



Figure W10.1. Black appears to have a deadly attack.



Figure W10.2. Now Black must go on the defensive.

23. Qxb7+ Ke8
24. Rge1! {(Figure W10.3)}



Figure W10.3. Now Black is devastated.

EXAMPLES FROM OTHER SYSTEMS

(1) Termination of employees [business]

I once worked at a startup company that, I only later found out, had been defrauding its investors the whole time it was in operation. My manager was supposed to be the chief scientist, but because his incompetence was being hidden from the investors, my effective supervisor was someone far less educated, less intelligent, and less wise. This chain reaction of problems led to that supervisor coming to the ridiculous conclusion that the reason I was not making more progress on writing computer code was because I was afraid of success, and he secretly convinced the chief scientist of his hypothesis. The actual reason for the slow progress was that the very elderly chief scientist had become so incompetent that I could not get the design information I needed from him to know what to code, but the supervisor did not want to consider that possibility when I told him the real problem, therefore the supervisor terminated me. However, unknown to all of us in the company, the investors had placed me in that job as an unwitting spy of sorts, because they were suspicious about the lack of progress in that company, and they trusted me to relay truthful information on what was going on there. The same day the investors heard that I had been terminated, which was contrary to the employment contract they had dictated to the company that I have, they called an emergency meeting. The result of the meeting was that they reluctantly accepted the supervisor's decision to terminate me, but only under the condition that there be no more personnel changes until the project was finished.

Later I learned that the person the supervisor hired to replace me lasted only one week before he quit, apparently also realizing how dysfunctional the company was. As a result, the investors withdraw all further funding from the company, never brought the additional investors into the project they had intended, the company that took five years to build then folded, the chief scientist died a few months later, took his supposed breakthrough idea to the grave with him without ever making any money from it, and the supervisor who had no other income or place to live presumably became homeless because he had been living at the chief scientist's house. All this happened because they launched an ill-founded attack on me while operating with extremely unsound foundations!

Principle W11:

Surprises are often effective in warfare.

EXAMPLES FROM CHESS

(1) Surprise openings

There exists a tradeoff between surprise and soundness. Since the strongest moves are the best known, deviating from well-known moves for the sake of surprise value carries a risk proportional to the amount of surprise. Surprise value works particularly well against bookish opponents who memorized opening lines without understanding why those particular moves are played in that particular order, but it does sometimes catch a strong opponent unprepared and unable to counter the move effectively.

In the following game, former world champion Anatoly Karpov encountered an extremely unusual response at the very first move, called the St. George Defense. Some of the audience even snickered when they saw the move 1...a6 played in this game because it is normally played only by beginners who do not know enough to challenge the center immediately. However, Karpov eventually lost the game, an outcome that generated a lot of unjustified interest in the opening, even though the opening is still as weak as it ever was. This was a case where the element of surprise prevailed over a stronger opponent.

1. e4 a6 {St. George Defense. {(Figure W11.1)}
2. d4 b5
3. Nf3 Bb7
4. Bd3 Nf6
5. Qe2 e6
6. a4!? c5!?
7. dxc5 Bc5
8. Nbd2 b4
9. e5 Nd5
10. Ne4 Be7
11. O-O Nc6!
12. Bd2 Qc7
13. c4 bxc3
14. Nc3 Nxc3
15. Bxc3 Nb4!
16. Bb4 Bxb4
17. Rac1 Qb6
18. Be4 O-O!
19. Ng5!? h6
20. Bh7?! Kh8
21. Bb1 Be7
22. Ne4 Rac8
23. Qd3?? Rc1
24. Rc1 Qb2



Figure W11.1. Black springs a surprise opening.

25. Re1? Qxe5 {(Figure W11.2)}
26. Qd7 Bb4
27. Re3 Qd5
28. Qd5 Bd5
29. Nc3 Rc8
30. Ne2 g5
31. h4 Kg7
32. hg5 hg5
33. Bd3 a5
34. Rg3 Kf6
35. Rg4 Bd6
36. Kf1 Be5
37. Ke1 Rh8
38. f4 gf4
39. Nf4 Bc6
40. Ne2 Rh1
41. Kd2 Rh2
42. g3 Bf3
43. Rg8 Rg2
44. Ke1 Be2
45. Be2 Rg3
46. Ra8 Bc7 {0-1. Anatoly Karpov vs Anthony Miles. 01, EU-chT Skara ;EU-chT (1980). {(Figure W11.3)}



Figure W11.2. Black now has a positionally won game.



Figure W11.3. White resigns in a lost endgame.

EXAMPLES FROM OTHER SYSTEMS

(1) Ambush predators [animal behavior]

Many animals, namely those in the category of ambush predators (“Ambush predator.”), capture their prey by lying quietly in wait until the prey comes near enough to catch. The function of play in animals is believed to be instinctive practice for such real-life surprise attacks (Goldman 2013).



Principle W12:

A common warfare practice is to probe weaknesses.

EXAMPLES FROM CHESS

(1) Probing weaknesses

Often a rook or queen will shift from kingside to queenside, or vice versa, to test the reaction of the opponent. This is called “probing weaknesses.” Such probes may elicit an erroneous defensive move, such as moving a pawn in front of the castled king or misplacing a protective piece, that can be exploited.

In the following game, Fischer mentions how ideal his position as White is, since White has the luxury of shifting his rook to either wing (manifested here as 24. Ra3) as a method of “probing weaknesses,” such as temporarily threatening Black's unprotected a6-pawn. Fischer eventually wins.

1. e4 c5 {Sicilian Defense.}
2. Nf3 d6
3. d4 cxd4
4. Nxd4 Nf6
5. Nc3 a6 {Najdorf Variation.}
6. h3 {Adams Attack.} Nc6
7. g4 Nxd4
8. Qxd4 e5
9. Qd3 Be7
10. g5! Nd7
11. Be3 Nc5?
12. Qd2 Be6
13. O-O-O O-O



Figure W12.1. White's rook can roam the 3rd rank.

14. f3 Rc8
15. Kb1 Nd7
16. h4 b5
17. Bh3 Bxh3
18. Rxh3 Nb6
19. Bxb6 Qxb6
20. Nd5 Qd8
21. f4 exf4
22. Qxf4 Qd7
23. Qf5 Rcd8 {(Figure W12.1)}
24. Ra3! {(Figure W12.2)} Qa7



Figure W12.2. Probing the undefended a6-pawn.

25. Rc3 g6!
26. Qg4 Qd7
27. Qf3 Qe6
28. Rc7 Rde8
29. Nf4 Qe5
30. Rd5 Qh8
31. a3 h6
32. gxh6 Qxh6
33. h5 Bg5
34. hxg6! fxg6
35. Qb3! Rxf4
36. Re5+ Kf8
37. Rxe8+ {1-0. Fischer vs Julio Bolbochan. Stockholm 1962. Analysis:} Kxe8
38. Qe6+ Kf8
39. Qc8+ Bd8
40. Qxd8# {(Figure W12.3)}



Figure W12.3. White finally mates.

EXAMPLES FROM OTHER SYSTEMS

(1) Car burglars [criminology]

A common practice of homeless burglars is to slap, knock on, or rock a vehicle parked on a public

street to test if it has an alarm or if anyone is inside. If there is no alarm or response from an occupant in the vehicle or from a person watching, that indicates to the burglar that he can probably break in and steal CDs or something else from the vehicle without being quickly detected or thwarted.

R. REPRESENTATION

Principle R1:

Every useful representation has an advantage and a disadvantage.

EXAMPLES FROM CHESS

(1) Algebraic notation versus descriptive notation

Algebraic notation is the official notation mandated by chess tournaments and recommended for chess publications and chess software, but it has disadvantages that the earlier notation--descriptive notation--did not have. Some of the disadvantages of algebraic notation are:

- Similarity of moves between White and Black are difficult to see. For example, in algebraic notation 1. Nf3 Nf6 2. g3 g6 3. Bg2 Bg7 is not very obviously a symmetrical position, but in descriptive notation 1. N-KB3 N-KB3 2. P-KN3 P-KN3 3. B-N2 B-N2 it is obvious that each side has made identical moves because the pairs of move names are identical.
- Double the amount of notation is required to convey any concept that refers to the same relative location for either side. For example, the weakest square for both players is represented in algebraic notation as “f2 or f7” whereas in descriptive notation it is represented simply as “KB2.”
- The unit being captured is not shown. For example, does 14. Bxd7+ mean that White captured a bishop, a knight, or some other type of unit? In algebraic notation 14. BxN+ this would be obvious. This problem with algebraic notation makes it more difficult to keep track of which side is ahead on material when looking only at notated moves.
- The notation becomes completely inverted in a relative sense whenever playing Black, which increases the likelihood of errors when writing down moves during a game as Black. For example, as White the lower left corner is a1, but as Black the lower left corner is h8.

However, an equal number of corresponding disadvantages exist for descriptive notation:

- Since descriptive notation does not always require the queenside versus kingside to be specified, a move such as “White's B-N5” could mean Bb5 or Bg5.
- An additional term is required to describe a specific location. For example, to describe f7 but not f2, one must write “Black's KB2.”
- The location of a capture is not shown. For example, does 14. BxN+ mean that White captured the knight at d7, c6, b5, a4, f7, g6, h5, or other?
- Two representations exist to describe any given location. For example, a1 as White is QR1, but

as Black the same square is QR8.

One could combine both notations to remove all ambiguity, such as something like 1. KP-Ke4 KP-Ke5 2. KN-B3f3, but then the notation is roughly doubled in length for every move. Also, none of the notations described here indicate from which square a unit has moved, which is important information for a computer and for some diagrams. Also, none of the notations described here take advantage of left-and-right board symmetry (i.e., kingside and queenside), such as noting that the Sicilian Defense (1. e4 c5) and Dutch Defense (1. d4 f5) are mirror images of each other if the king and queen locations are ignored. To correct either of those deficiencies, yet another notation must be used. Therefore it is impossible to enjoy all the advantages of any single, concise notation.



Sicilian Defense.



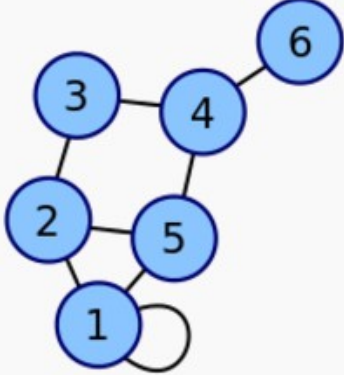
Dutch Defense.

The Sicilian Defense and Dutch Defense are essentially mirror images of each other.

EXAMPLES FROM OTHER SYSTEMS

(1) Adjacency matrices [computer science]

One alternative representation of a graph diagram is an adjacency matrix, which is a compact, square, numerical representation suitable for computers. One advantage of an adjacency matrix is that one can determine at a glance if two nodes of the graph are connected by checking the appropriate element of the matrix. Also, all the vertices of a given node can be determined easily by merely scanning across the appropriate row. (“Adjacency matrix.”) However, a major disadvantage of an adjacency matrix is that almost any other general observation about the graph is difficult to determine from the matrix, such as whether cycles look like squares or rectangles, the shapes of most of the cycles, which cycles are adjacent to other cycles, which nodes have only one link, any symmetry present in the graph, how and where hubs are located, and so on. Therefore neither representation is ideal for every application.

Labeled graph	Adjacency matrix
	$\begin{pmatrix} 2 & 1 & 0 & 0 & 1 & 0 \\ 1 & 0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 \\ 1 & 1 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \end{pmatrix}$ <p>Coordinates are 1–6.</p>

Y. PSYCHOLOGY

Principle Y1:

Memory assimilates patterns subconsciously that the brain sees frequently, both static patterns and temporal patterns, and alerts us to the presence of anomalies it detects after those normal training patterns have been learned.

EXAMPLES FROM CHESS

(1) Unit placement in the opening

After playing through many master games, one subconsciously learns the squares where each unit is most commonly placed during the opening phase of the game. Any deviation from the usual unit placement square alerts the brain of an anomaly, even when the reader was unaware that he was learning any such unit placement patterns. In other words, unusual piece placement immediately *looks* wrong, even if the observer does not immediately have a logical reason for why the move might be wrong. This automatic warning flag is a terrific signal that the player detecting it should pay close attention to the move's possible weaknesses, so as to exploit it properly.

In the following game (beretm9 2016), White plays Qb1 with the idea of supporting an advance of the b-pawn in a queenside attack. Although such a move might seem logical and reasonable to a beginner, it immediately looks very wrong to an experienced player. Only after some conscious thought and possibly introspection can the experienced observer give some logical reasons for why the move is in fact weak, such as: (1) It interferes with the rooks being connected. (Connecting rooks is a nearly universal goal in the opening phase of any chess game.) (2) It hides the queen, which ideally should be radiating its power from the center of the board, behind a wall of pawns near the edge of the board. (3)

The opening is the Sicilian Defense, where White normally attacks on the queenside and Black normally attacks on the kingside, therefore White is attacking on the wrong side of the board; (4) Normally rooks are the only pieces placed behind knight pawns in preparation for such pawn advances, not queens. (5) The squares to which White most often develops his queen in the Sicilian Defense are d2 and f3, and b1 not one of those squares. (6) “Developing” a piece almost always means moving it off the back rank, with the exception of rooks, so “developing” a queen to b1 is almost contrary to the very definition of development. Without such conscious analysis, however, the brain alerts the experienced player of an anomaly. Evidently the brain learns all these patterns (1) through (6) without even being aware that it learned them!

1. e4 c5 {Sicilian Defense.}
2. Nf3 e6 {Cramling Defense.}
3. d4 cxd4
4. Nxd4 a6 {Kan Variation.}
5. Be2 d6
6. O-O Qc7
7. Nc3 Nf6
8. Re1 Be7
9. Nf3 Nc6
10. a4 O-O
11. Be3 Bd7
12. Qb1 {(Figure Y1.1)} d5
13. exd5 Nxd5
14. Nxd5 exd5
15. Nd4 Nxd4
16. Bxd4 b5
17. axb5 Bxb5
18. Bxb5 axb5
19. Rxa8 Rxa8
20. Qd1 Rc8
21. Qg4 Bf8
22. c3 g6
23. Qg5 Qa5??
24. Qf6 b4
25. Qh8# {beretm9 vs NN. 2016.}



Figure Y1.1. This move looks very wrong.

(2) Duration and ease of attack

One temporal pattern in chess that is evidently learned subconsciously is the relative duration and ease of carrying out a given type of attack.

In the following game (Chahmatistick 2016), although White eventually queened his far advanced pawn as he had intended and then won, the length of time it took to do this and the difficulties encountered along the way, especially when Black gained strong counterplay by queening his own pawn at about the same time, strike an experienced player as all wrong. Black had far too much counterplay than normal, Black should not have been able to get his own queen at all, and White should have been able to queen his own pawn much earlier, possibly by some clever combination.

One suggested continuation shown below employs such a clever combination that uses the common endgame trick of promoting with check, followed by a potential discovered check. Although White initially loses an entire rook in this combination, only two moves later White is far ahead in material, he completely stifles any useful counterplay by White, he grabs the initiative by threatening immediate capture of Black's dangerous passed pawn with a discovered check, and that b-pawn will be captured by White on the next move, no matter what Black does. Such a combination now has the look, feel, duration, and overall style of professional play in such a situation. Compare that to how White actually played, where four moves later White was barely ahead on material and had no threats.

1. e4 e5
2. f4 {King's Gambit.} exf4 {King's Gambit Accepted.}
3. Nf3 Bc5
4. d4 Bb4+?!
5. c3 Bd6
6. c4 Nc6
7. Nc3 Nb4
8. a3 Na6
9. Bd3 Nf6
10. b4 O-O
11. e5 Ng4
12. exd6 cxd6
13. Bxf4 Qe7+
14. Qe2 Ne3
15. Qxe3 Qxe3+
16. Bxe3 d5
17. Nxd5 d6
18. Ne7+ Kh8
19. Nxc8 Raxc8
20. c5 dxc5
21. dxc5 Rce8
22. Ke2 Re7
23. Bxa6 bxa6
24. Rad1 h6
25. Rd3 Rfe8
26. Rhd1 a5
27. Rd8 Rxd8
28. Rxd8+ Kh7
29. Nd4 axb4
30. axb4 a5
31. b5 a4
32. c6 a3
33. Nc2 Re5
34. b6 Rc5
35. b7 Rxc6 {(Figure Y1.1)}



Figure Y1.1. White to play.



Figure Y1.2. As White actually played.

{As actually played:}

36. b8=Q {(Figure Y1.2)} Rxc2+

37. Rd2 Rc1

38. Rd3 a2

39. Qb2 a1=Q

40. Qxa1 Rxa1 {(Figure Y1.3)}

41. h4 Ra2+

42. Rd2 Ra8

43. g4 Ra4

44. g5 Rxb4

45. gxh6 gxh6

46. Rd4 Rh5

47. Rd7 Rh2+

48. Kd3 Rh1

49. Ke4 Rh4+

50. Ke5 Rh5+

51. Kf6 Rh3

52. Rxf7+ {1-0. Chahmatistick vs NN. 2006.}

{More efficient:}

36. Rh8+ {(Figure Y1.4)} Kxh8

37. b8=Q+ Kh7

38. Qb1 {(Figure Y1.5)}



Figure Y1.3. White's game 4 moves later.



Figure Y1.4. As White should have played.

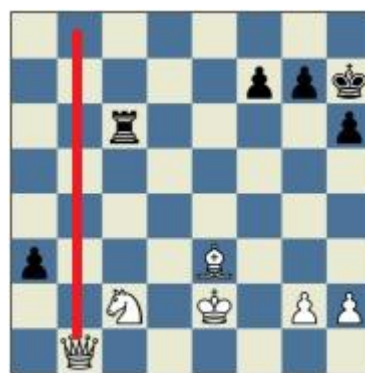


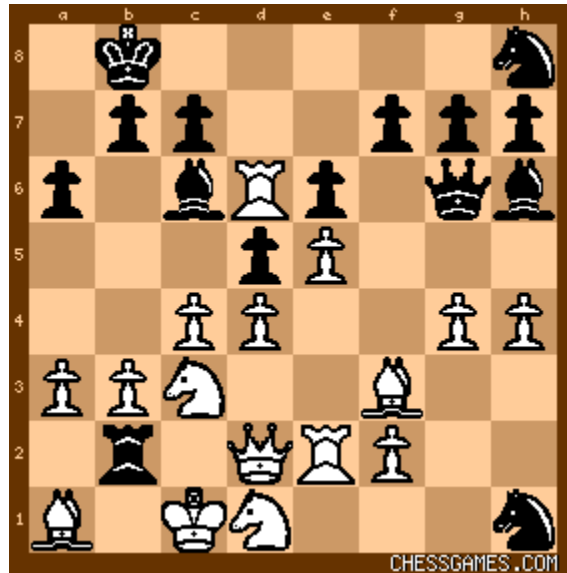
Figure Y1.5. White's game 2 moves later.

(3) Naturalness of a position

An experienced chess player can often detect at a single glance if a chess puzzle is composed versus natural (i.e., arising from a real game). Obviously this is not a conscious skill that is learned from books or coaches because it is a largely a useless observation that has no reason to be taught, but is instead founded on automatic, subconscious acquiring of patterns after a substantial amount of exposure to real chess positions. This acquired pattern recognition is unfortunate for film producers or model photographers, who often set up a random chess position during a film shoot or model shoot, thinking that such details do not make any difference or that no one will notice, only to have later generations of chessplayers endlessly criticize the photographed result as annoyingly unreal.

Composed problems often have perfect alignment of several adjacent units, which rarely happens in real games, or pieces in extremely unlikely positions (a knight in a corner, a rook behind enemy lines

where it would have been extremely difficult to penetrate, etc.), pieces in heavy clusters, pieces in large groups in the opponent's territory, and so on. Below is one such example.



An obviously composed chess problem.

EXAMPLES FROM OTHER SYSTEMS

(1) Musical skill [music]

One lead vocalist I knew in a rock band also played a little lead guitar on the side, though not very well. When the band's lead guitarist left the vocalist's band after a few years of playing with them, the band began auditioning for a replacement lead guitarist, whereupon the vocalist realized he now played lead guitar better than many of the guitarists they were auditioning! The vocalist told me that evidently he had assimilated the style and speed of their former lead guitarist after so many years, and had done so without even being aware of it.

(2) Body language [psychology]

Once while walking down the sidewalk along a city street I noticed a man approaching me from the opposite direction on the same sidewalk. My "intuition" (subconscious pattern recognition) immediately alerted me that something was wrong about the man's body language, and I thought to myself, "This guy's up to something." I had quite a few seconds in which to analyze my first impression, and in that time I realized that part of the set of anomalies I was detecting was that he was walking too slowly and nonchalantly, and was not paying the normal amount of attention that a stranger would give to another stranger approaching him. In other words, he was deliberately ignoring me and deliberately acting too casually, as if not to alert me of his bad intentions. I went on the defensive as I got close to him, anticipating a possible assault. When he got within speaking distance of me, he did ask me for a handout of money, although he was polite about it, not physically threatening. In conclusion, my intuition was certainly correct, although my exact expectation was inaccurate. My subconscious obviously had picked up clues before my conscious had, by detecting various combined anomalies coming from the same source. Even animals have this ability to detect minuscule anomalies, especially dogs, so such ability serves a survival purpose in real life, which we can use for survival in chess.

(3) French language [natural language]

The French language has two genders: masculine and feminine. One textbook on French for English speakers notes that one trick for learning the gender of a noun is to always practice saying that noun together with its proper article, which is also gender specific and must agree with the noun's gender. For example, “la gare” is the proper pairing (feminine article, feminine noun) for the French words for “the station,” and it sounds correct, but if someone were to say “le gare” (masculine article, feminine noun), any listener sufficiently familiar with French would automatically cringe at the pronunciation because it would sound so wrong, even if technically the two words still mean “the station.” In this case it is likely the brain learned this proper pairing subconsciously by noting that the “a” sound was common to both words.

Principle Y2:

The mastery of most skills requires both a knowledge component and automatic reflex component. The two components are both learned by the brain, but are different in their contribution to the skill, so both are required for practical mastery. The two components can also be considered the strategic component and tactical component.

EXAMPLES FROM CHESS

(1) Strategy without sufficient tactics

Typically in chess, strategy is a set of heuristics with logic that together allow a player to reach a positionally superior position where a win exists in the form of a winning combination, but that winning combination requires the ability to detect its existence and then to visualize a specific set of lines far enough to confirm that they all win. Such a combination is often difficult to detect because it usually involves anti-positional and anti-material moves that are contrary to all the heuristics that were used up to the point where the combination appeared. A common problem with beginning chessplayers is that they reach a level of positional skill where can play strategically well enough to get into a winning position, but then lack the tactical skill to complete the win. It does little good to know how to get into a winning position if one cannot complete the overall task of winning the game!

In the following game (magic2046 2016), after White overlooked several winning moves, Black obtained a positionally superior position, but then overlooked a clever winning combination involving a piece sacrifice, slowly drifted into passivity, made some mistakes, and then finally lost. What a waste: He could have won White's queen with just a 2-move combination!

<ol style="list-style-type: none">1. e4 e6 {French Defense.}2. d4 d53. exd5 {Exchange Variation.} exd54. Bd3 Nf65. Nc3 c56. Bg5 c47. Be2 Be68. Nf3 h69. Bh4 Be7	
---	--

10. Qd2 Nbd7
11. a3 Nb6
12. Bg3 Qd7?
13. Ne5 Qd8
14. Nd1 Ne4
15. Qe3 Bf6
16. Bf3 Nxc3
17. hxg3 Bg5
18. Qe2 O-O
19. c3 Re8
20. Ne3 Nd7
21. Nxf7? Kxf7
22. Bh5+ Kg8
23. Bxe8 Qxe8
24. O-O-O Nf6
25. Kb1 Ne4
26. Nf1?? {(Figure Y2.1)} Qb5?
{(Figure Y2.2)}
27. Ka1 Be7
28. f3 Bg4!!
29. fxg4 Bxa3!?
30. bxa3 Nxc3
31. Qe6+ Kh7
32. Ne3 Qa4?
33. Rxh6+ gxh6
34. Qf7+ Kh8
35. Qf6+ Kg8
36. Qe6+ Kg7?? {1-0. NN vs
magic2046. 2016. {(Figure Y2.3)}

- {Analysis:}
- 26... Nxc3+! {(Figure Y2.4)}
 27. bxc3 Bf5+ {(Figure Y2.5)}



Figure Y2.1. Black to play and win.



Figure Y2.2. How Black actually played.



Figure Y2.3. Black resigned here.



Figure Y2.4. What Black should have played.



Figure Y2.5. Black could have won White's queen!

EXAMPLES FROM OTHER SYSTEMS

(1) Photography [photography]

Book learning of photography teaches the aspiring photographer technical knowledge (e.g., f-stops), artistic guidelines (e.g., elements of composition), practical information (e.g., how to behave with models), and more. Although such book knowledge is valuable, it is useless if the photographer cannot actually take photos that are in focus and have proper exposure, especially quickly without conscious thought. The latter requirements are the tactical component, since they involve rapid physical responses such as adjusting the focus knob in the correct direction without needing to think about it. Conversely, a tactically skilled photographer who handles his camera adroitly to take photos with high technical quality can easily lack artistic ability, resulting in high quality photos that are of no interest.

S. OTHER SYSTEMS

Principle S1:

Oftentimes the simplest structure is the best; “improvements” often have major drawbacks.

EXAMPLES FROM CHESS

(1) The danger of disturbing your pawn phalanx in front of your castled king

Usually the safest pawn structure in front of your castled king is the original phalanx of (usually three) horizontal pawns. If any of those pawns are moved then a weakness is created that might be exploitable by the opponent, depending on the exact position and the opponent's skill. Therefore one strategy in chess is to force one or more of those protective pawns to advance, which if accomplished, creates various targets on which to base an attack on the castled king.

In the following game (Chernev 1998, p. 23), Colle as White forces the advance of two such protective pawns, which combined create a positionally fatal position that can be exploited by methods such as Colle's knight sacrifice.

1. d4 d5
2. Nf3 Nf6
3. e3 e6
4. Bd3 c5
5. c3 {Colle System.} Nc6
6. Nbd2 Be7
7. O-O c4
8. Bc2 b5
9. e4! dxe4
10. Nxe4 O-O
11. Qe2 Bb7
12. Nfg5! {(Figure S1.1)} h6 {(Figure S1.2)}
13. Nxf6+ Bxf6
14. Qe4 g6 {(Figure S1.3.)}
15. Nxe6! fxe6
16. Qxg6+ Bg7
17. Qh7+ Kf7
18. Bg6+ Kf6
19. Bh5 Ne7
20. Bxh6 Rg8
21. h4 Bxh6
22. Qf7# {Colle vs Delvaux. Gand-Terneuzen 1929.}



Figure S1.1. No disturbance in Black's phalanx.



Figure S1.2. First disturbance in Black's phalanx.



Figure S1.3. Second disturbance in Black's phalanx.

EXAMPLES FROM OTHER SYSTEMS

(1) Paper clips [engineering]

One recent attempted improvement to paper clips was to put a bend across the inner loop at one end to raise that loop into three dimensions to make the clip easier to slide onto a piece of paper. However, this created more problems than it solved because then the user then had to take extra time with each paper clip to make sure the bend was going in the right direction so as not to bend the paper unnecessarily, which would happen if the clip were put on in the wrong direction. Also, many unofficial uses of paper clips were nullified, such as their use as a screwdriver, or as a flat pad to raise the height of one table leg that is too short, since a bent paper clip would gouge the floor.



Principle S2:

“Best” has no specific meaning unless put into context with a goal, style, taste, personal values, philosophy, or popularity.

EXAMPLES FROM CHESS

(1) Choice of 1. e4 versus 1. d4

The two most popular opening moves for chess are 1. e4 and 1. d4. A very common beginner's question is which move is “best.” Although some grandmasters have strong personal preferences for one or the other, most grandmasters admit that neither move is best, only different in nature, and statistics corroborate this. In particular, 1. e4 brings the game to a crisis stage earlier, which can allow White to win faster, but often the correct defense for an e4 opening is also easier for Black to see, so that once that early crisis is averted, the game ends in an early draw. In contrast, although 1. d4 tends to make the game longer, the defense for Black tends not to be as obvious, and there is more time for Black to go wrong by not being able to see the correct defense. Therefore the choice of which is “best” is only a matter of personal taste, which is based on personal, subjective values. (Alburt and Parr 1997, pp. 119-120)

- 1. e4 {King's Pawn Opening. #1 pop. w 38%.}
- 1. d4 {Queen's Pawn Opening. #2 pop. w 38%.}

(2) White's fourth move in the Nimzo-Indian Defense

In the Nimzo-Indian Defense, White has seven excellent choices of his fourth move, each of which has strong advocates. Although the selections differ in popularity and outcome statistics, no choice is clearly “best.” (Chernev 1998, p. 160)

- 1. d4 Nf6
- 2. c4 e6
- 3. Nc3 Bb4 {Nimzo-Indian Defense.}

The seven most popular responses are:

- 4. e3 {#1 pop. n 38%.}
- 4. Qc2 {Classical Variation. #2 pop. n 39%.}
- 4. Nf3 {Three Knights Variation. #3 pop. n 38%.}
- 4. f3 {Kmoch Variation. #4 pop. w 38%.}
- 4. Bg5 {Leningrad Variation. #5 pop. b 38%.}
- 4. a3 {#6 pop. b 39%.}
- 4. Bd2 {#7 pop. b 48%.}

(3) Best opening

There does not exist any “best” opening, in general. Partly this is because each player has his own set of strengths and weaknesses, which in turn influence that player's style and taste. As Chernev wrote “The best openings to play are the ones you are most at home in.” (Chernev 1998, p. 44) For example, the “best” response to 1. e4 for players who prefer drawish positions would probably be 1...e4, since this move creates a symmetrical position, and symmetrical positions have a tendency to be drawish. In contrast, the response 1...c5 could be considered “best” for players who prefer uncompromising

positions with sharp tactics and ongoing struggle for both sides, since this move creates an asymmetrical position.

EXAMPLES FROM OTHER SYSTEMS

(1) “Best” scuba diving location [sports]

In autumn 1968 an article in Skin Diver magazine mentioned that the “best” scuba diving location might be considered the Maldivé Islands in the Indian Ocean, largely due to its unspoiled reefs and 200-foot underwater visibility, but an airline ticket to there from the United States would cost thousands of dollars, and there were few or no diving facilities there at the time, so the author concluded that “best” was a useless concept unless put into context of a particular individual's budget, amenities at the location, and other considerations.



Snorkeling in the Maldivé Islands.

(2) “Best” car [everyday life]

Flashy and practical are generally incompatible. For example, a Lamborghini is a flashy sports car and a common status symbol that suggests it is the “best” car one can buy, but it is an extremely impractical vehicle with limited trunk space for hauling household appliances, and uncomfortable seating for senior passengers, not to mention having an extremely high price and being a target for car thieves and police.



The trunk of a Lamborghini.

(3) “Best” soccer strategy [sports]

There does not exist a “best” strategy in soccer (Soccer-Training-Methods.com). The strategy chosen at any given time should depend on the strengths and weaknesses of your own team and those of your opponent's team, among other things, which implies the chosen strategies will typically vary with each game, and will vary throughout a single season.

Principle S3:

Infinite loops arise naturally in most complex systems.

EXAMPLES FROM CHESS

(1) Perpetual check

It is not uncommon for a chess game to end in perpetual check, meaning that one player can check his opponent endlessly, which is a type of infinite loop. This unending action is allowed in chess, and is considered a draw after a position has repeated itself three times, provided the checking player claims the draw. A perpetual check might be desirable to avoid risk of loss later on, or it might be the only way to avoid losing.

In the following game (“Robert James Fischer vs Mikhail Tal: 'French Drawings.'”) Tal as Black creates an extremely complicated situation that settles into a perpetual check as a way of drawing in a position that would otherwise be lost due to being too far behind in material.

1. e4 e6 {French Defense.}
2. d4 d5
3. Nc3 {Paulsen Variation.} Bb4 {Winawer Variation.}
4. e5 c5
5. a3 Ba5
6. b4 cxd4
7. Qg4 Ne7
8. bxa5 dxc3
9. Qxg7 Rg8
10. Qxh7 Nbc6
11. Nf3 Qc7
12. Bb5 Bd7
13. O-O O-O-O
14. Bg5 Ne5
15. Nxe5 Bxb5
16. Nxf7 Bxf1
17. Nxd8 Rxc5
18. Nxe6 Rxc2+
19. Kh1 Qe5
20. Rxf1 Qxe6
21. Kxg2 Qg4+ {1/2-1/2. Robert James Fischer vs Mikhail Tal. Leipzig Olympiad Final, 1960. (Figure S3.1) Analysis:}
22. Kh1 Qf3+
23. Kg1 Qg4+
24. Kh1 Qf3+
25. Kg1 Qg4+



Figure S3.1. Black has White in perpetual check.

(2) Pursuit

Another type of infinite loop that occurs in chess is called “pursuit.” This is a situation where one piece continually attacks another piece that continually moves to escape but the attacking piece can pursue it indefinitely.

The following game (chessbase 2007) shows one possible line where White would likely have drawn instead of lost if he had opted for infinite pursuit that involved the unending threat of trading bishops.

1. e4 e5
2. Nf3 Nc6
3. d4 {Scotch Opening.} exd4
4. Nxd4 Bc5
5. Nxc6 Qf6
6. Qf3 bxc6
7. Qg3 h5
8. h4 Nh6
9. f3 d5
10. Nc3 Bd4
11. Bd2 Rb8
12. 0-0-0 Be5
13. f4 Bd4
14. Qd3 Bg4
15. e5 Bxc3!
16. Qxc3 Qe6
17. Re1 0-0
18. Be3 Rfd8
19. Qc5 a5
20. Kb1 a4
21. Bd3 Bf5 {Sergei Rublevsky vs Alexander
Grischuk. FIDE candidate matches Tiebreak Elista
(1), 13.06.2007. (Figure S3.2) Analysis:}
22. Be2 Bg4 {(Figure S3.3)}
23. Bd3 Bf5
24. Be2 Bg4
24. Bd3



Figure S3.2. Black tries to trade from f5.



Figure S3.3. Black tries to trade from g4.

EXAMPLES FROM OTHER SYSTEMS

(1) Jupiter's Great Red Spot [astronomy]

The Great Red Spot on the planet Jupiter is a storm that some believe has been swirling for over 300 years. ("Great Red Spot.") It arose naturally and has been an extremely persistent natural phenomenon despite it being composed only of clouds, not of solid material, and despite it being surrounded by chaotic clouds.



The Great Red Spot of Jupiter.

(1) Belousov–Zhabotinsky reaction [chemistry]

The Belousov–Zhabotinsky reaction is a class of chemical reactions that do not reach equilibrium for a long period of time, but instead oscillate between different states, and evolve in a chaotic way.



A Belousov–Zhabotinsky chemical reaction in a dish.

Principle S4:

Complex systems typically exhibit symptoms of impending failure when they become sufficiently stressed.

EXAMPLES FROM CHESS

(1) Pieces forced to retreat to the back rank

Probably the most common symptom that a player is losing is that he must defend by moving one or more of his developed pieces back to the back rank. The most common and noticeable piece to make such a retreat is probably the knight, although bishops, rooks, and queen are also sometimes forced into such a retreat. Since it is a well-known adage that knights do not belong on the edge (“A knight on the rim is grim.”), a knight on the back rank is not only conspicuously on the edge, but typically also on the defensive. The presence of such a retreat is only a heuristic, however, since there do exist good reasons to occasionally move a knight to the back rank, such as repositioning or beginning an excursion to an outpost in the opponent's territory.

(2) Uncoordinated pieces

One symptom of a declining chess position is that the pieces get out of coordination, especially in the form of disconnected rooks. This symptom is often present with the additional symptom of pieces being forced to the back rank.

In the following game (Fischer 1972, pp. 306-310), Fischer as White points out Black's humorously uncoordinated position on the 24th move as “All Black's pieces are stepping on each other's toes.” This uncoordination allows White to mate only three moves later.

1. e4 e5
2. Nf3 Nc6
3. Bc4 Bc5 {Giuoco Piano.}
4. b4!? {Evans Gambit Declined.} Bxb4 {Evans Gambit.}
5. c3 Be7
6. d4 d6?
7. dxe5 Nxe5
8. Nxe5 dxe5
9. Qh5! g6
10. Qxe5 Nf6
11. Ba3! Rf8
12. O-O Ng4
13. Qg3 Bxa3
14. Nxa3 Qe7!
15. Bb5+ c6
16. Nc4! Qe6!
17. Rad1! cxb5
18. Qc7 Bd7
19. Nd6+ Ke7
20. Nf5+! gxf5
21. exf5 Rac8
22. Rxd7+! Qxd7
23. f6+! Nxf6
24. Re1+ {(Figure S4.1)} Ne4
25. Rxe4+ Kf6
26. Qxd7 Rfd8 {{Fischer vs Celle. California 1964: Exhibition Tour. Analysis:}}
27. Qe7+ Kg7
28. Rg4+ Kh8
29. Qf6# {(Figure S4.2)}



Figure S4.1. Black pieces are in each other's way.



Figure S4.2. Black is mated three moves later.

(3) Pieces moved into one's corners

A particularly severe version of retreating a developed piece to the back rank is retreating such a piece to one's own corner. Although bishops often frequent the corner squares (at R1) due to being finachetted one square away (at N2) after refusing to be traded during the middlegame, and rooks often frequent the corners when the rook pawns have disappeared in the middlegame or endgame, knights and queens rarely occupy corner squares since their power is best manifested in the center. Therefore a knight or queen being forced to occupy a corner square, especially when further hemmed in by surrounding pawns, is usually a symptom of a very bad position where defeat is near.

EXAMPLES FROM OTHER SYSTEMS

(1) Chlorosis [botany]

When a normally green plant turns yellowish, its new condition is called chlorosis. Chlorosis is a sign that something is wrong that is causing that plant to reduce its normal amount of chlorophyll, the substance that makes it green. This symptom is a very general indicator, however: it does not identify the specific cause of the plant's stress, only that stress is present. Some possible causes of chlorosis are mineral deficiency, unsuitable soil pH, damaged roots, pests, fungus, and many more. ("Chlorosis"; admin 2015)



Palm trees with chlorosis.

(2) Decline of the USSR [politics]

In the years prior to the collapse of the Soviet Union in 1991, signs of its failure become open and obvious, even to foreign travelers. Poverty was widespread, shop shelves were often bare, long food lines were common, prostitution was common, street musicians abounded to play for money (Daily Mail Reporter 2015), and the black market operated openly on the streets.

(3) Low body temperature [medicine]

Body temperature is one of the primary, easily measurable indicators of human health. In most cases all living organisms function best when the values of their functions are roughly centralized within certain limits. For example, a long-term, unusually low body temperature is a symptom of some health

problem. Although low body temperature does not specify the exact cause, some possible causes are infection, diabetes, stress, alcohol/drug abuse, shock, cancer, and more. (Sircus 2015)

Principle S5:

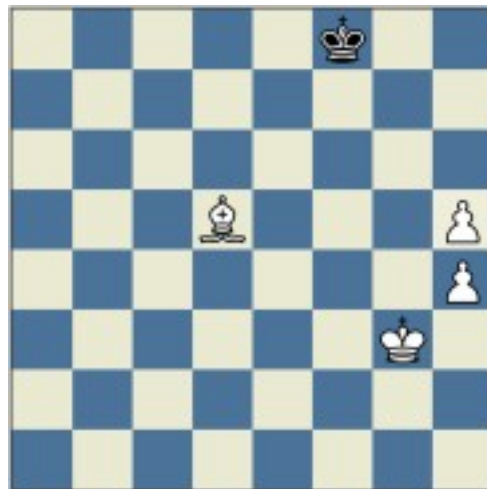
Complex systems often contain subsystems that cannot interact, even though those subsystems appear to share the same physical domain.

EXAMPLES FROM CHESS

(1) Opposite colored bishops

Bishops that travel on opposite colors can never interact in any way: they cannot capture each other, threaten each other, or block each other. This situation has the practical consequence in that the presence of opposite colored bishops, one for each player, in a bishop-and-pawns endgame prevents the game from being winnable by the player with the superior force in many cases. This is often true even when two pawns ahead in material, whereas normally even a one pawn superiority is normally winnable.

In the following position (Alburt and Lawrence 2008, pp. 78, 79) the position is a known theoretical draw. Even though White is ahead a bishop and two pawns, the promotion square's color (black) cannot be covered by the bishop because the bishop is confined to the opposite colored square (white), therefore the bishop cannot protect the leading pawn as it promotes.



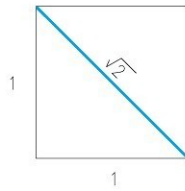
White is materially ahead in this position but cannot force a win.

EXAMPLES FROM OTHER SYSTEMS

(2) Rational and irrational numbers [mathematics]

Both rational and irrational numbers exist on the same number line, but no amount of multiplication or division by natural numbers, or even multiplication and division at the same time, can cause one type

of number to become the other type. This is astonishing since members of either the rationals or irrationals are positioned arbitrarily close to each other on the number line. It is as if two screens, each infinitely finely meshed, are overlaid but still have no points that overlap.



The length of the diagonal is approximately 1.414213562373.

For example, the square root of two, $\sqrt{2}$, which is the distance across the diagonal of a square whose sides are each of length 1, and whose value is approximately 1.414213562373 (and *only* approximately, since the entire decimal value can never be written), can be approximated to any degree of accuracy by rational numbers (Joyce 2015), but it can never be exactly equal to any of them, no matter how large the numerators and denominators are that are used in the approximation. For example:

$$3/2 = 1.5 > \sqrt{2}$$

$$7/5 = 1.4 < \sqrt{2}$$

$$17/12 = 1.416... > \sqrt{2}$$

$$41/29 = 1.413... < \sqrt{2}$$

$$99/70 = 1.41428... > \sqrt{2}$$

$$239/169 = 1.41420... < \sqrt{2}$$

$$577/408 = 1.414215... > \sqrt{2}$$

Principle S6:

Every complex system has some attributes that are describable by constants.

EXAMPLES FROM CHESS

(1) Material:tempi ratio

The presence of successful gambits in chess makes it clear that material (as measured in material points) can be exchanged for a time advantage (as measured in tempi), and vice versa. This is most commonly seen with gambits of pawns, especially in the opening, such as in the well-known King's Gambit (1. e4 e5 2. f4) or the lesser known Blackmar Gambit (1. d4 d5 2. e4). This phenomenon raises the obvious question as to how much material is worth how much time. This question can be worded more accurately as: What is the material:tempi ratio for the system of chess?

Fortunately, the answer is known through both rough heuristics and extensive computer experimentation. Heuristics say that, on the average, one pawn, which is worth 1 material point, is worth 3 tempi, which produces the material:tempi ratio of 1/3. Similarly, extensive computer experimentation has shown that, on the average, one tempo is worth 0.333 pawns, which produces a material:tempi ratio of $0.333/1 = 0.333$, which is in extremely close agreement with the heuristic value

of 1/3, out to three decimal places. This constant $k = 0.333$ is therefore a naturally emergent constant from the system of chess.

This constant can be of high practical value because a player can and should keep a mental tally of the number of lost tempi his opponent has made. Since the safe win of one pawn by one player usually means that same player will (eventually) win the game, the closer the lost pawn count approaches 1, or equivalently the closer the lost tempi count approaches 3, the more certain a player can be that he has a winning game, very often in the form of a clever combination. As a rough guide a player can expect the following conditions based on the following counts of tempi his opponent has lost:

1 lost tempo (= .333 pawns) by opponent: You have gained the initiative.

2 lost tempi (= .667 pawns) by opponent: You have a strong attack and may very well have a winning position.

3 lost tempi (= 1 pawn) by opponent: You are virtually guaranteed to have a winning position.

A player should definitely start looking for winning combinations at two lost tempi, and at three or more lost tempi a winning combination is virtually guaranteed to exist.

An interesting caveat to this heuristic, however is that the value of this constant k is only an *average* value derived from many thousands of chess games, which suggests that each chess position has its own unique, slightly altered value of k . For example, in an extremely closed position where all progress is greatly slowed due to a large, locked pawn formation, the value of k will probably have decreased. (It would be an interesting addition to future published books on chess openings to specify the value of k for each opening!) It is interesting to note that if our physical universe worked this way, then the speed of light, Planck's constant, and many other physical constants would be variable instead of constant: their values would be depend on the galaxy in which they were measured!

(2) Maximum denudation rate [original research]

One measurable attribute of a given chess game, chess opening, or chess position could be called the "denudation rate": the rate at which units disappeared from the board by being captured. Certain openings such as the Ruy Lopez tend to have many units on the board for a long time, therefore have a low denudation rate, whereas others like the Austrian Defense are just the opposite, with a high denudation rate.

The obvious way to measure this rate is by the average number units captured per ply, but the resulting value is not very meaningful without some knowledge of what a normal rate is. A more intuitive measure would be a percentage that compares the observed denudation rate to the maximum possible denudation rate. With this latter method 100% would mean the observed denudation were the fastest rate possible, and 0% would be the theoretical lower limit, which would be reached in any position that is considered before any units have been captured at all.

Fortunately, experimentation has discovered what is believed to maximum denudation rate. The fastest complete denudation known happens in 16.5 moves, or more conveniently expressed as 33 ply. (abivasu 2016.) 33 is therefore is a natural, emergent constant from the system of chess. The conjectured percentage of denudation rate (PDR) can therefore be measured as the ratio of the observed denudation rate (ODR) to the maximum denudation rate (MDR), or:

$$\text{PDR} = \text{ODR}/\text{MDR}$$

Since there exist 30 capturable units on a chessboard (the two kings are not capturable), then complete denudation of all capturable pieces in 33 ply means:

$$\text{MDR} = 30 \text{ units} / 33 \text{ ply} = 0.909 \text{ units/ply}$$

This constant MDR could be considered another chess constant, though one that is a slight variation of the above constant of 33 ply.

One theoretical “game” that produces maximum denudation rate (100%) is the following:

1. e4 d5 {Scandinavian Defense.}
2. exd5 Qxd5
3. Bd3 Qxa2
4. Bxh7 Qxb1
5. Bxg8 Qxc2
6. Bxf7+ Kxf7
7. Rxa7 Qxc1
8. Rxb7 Rxh2
9. Rxb8 Rxg2
10. Qxc1 Rxg1+
11. Rxg1 Rxb8
12. Qxc7 Rxb2
13. Qxc8 Rxd2
14. Qxf8+ Kxf8
15. Rxg7 Rxf2
16. Rxe7 Kxe7
17. Kxf2

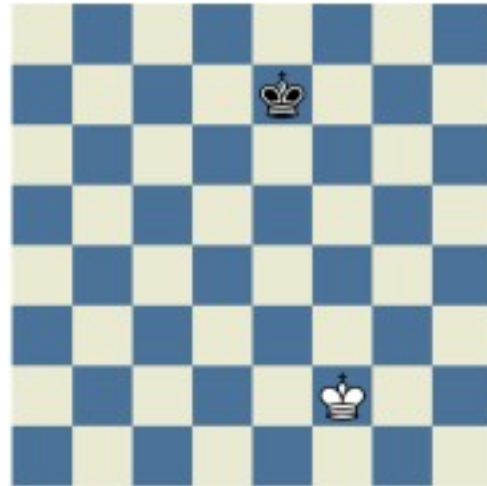


Figure S6.1. Fastest known complete denudation.
ODR = 30 units / 33 ply = 0.909 units/ply
PDR = ODR/MDR = 0.909 / 0.909 = 1.00 = 100%

An example of a position far into the opening with relatively low denudation rate (15.0%) is the following Ruy Lopez variation:

1. e4 e5
2. Nf3 Nc6
3. Bb5 {Ruy Lopez.} a6
4. Ba4 Nf6 {Morphy Defense.}
5. O-O Be7 {Closed Defense.}
6. Re1 b5
7. Bb3 d6
8. c3 O-O
9. h3 Na5
10. Bc2 c5
11. d4 Qc7 {Chigorin Defense.}
12. Nbd2 cxd4
13. cxd4 Nc6
14. Nb3 a5
15. Be3 a4
16. Nbd2 Bd7
17. Rc1 Qb7
18. Qe2 Rfe8
19. Bd3 Rab8
20. dxe5 Nxe5
21. Nxe5 dxe5
22. Bc5 Bc6



Figure S6.2. Low denudation rate.

$$\text{ODR} = 6 \text{ units} / 44 \text{ ply} = 0.136 \text{ units/ply}$$

$$\text{PDR} = \text{ODR}/\text{MDR} = 0.136 / 0.909 = 0.150 = 15.0\%$$

In contrast, an example of a position far into the opening with relatively high denudation rate (39.6%) is the following Austrian Defense variation:

1. d4 d5
2. c4 {Queen's Gambit.} c5 {Austrian Defense.}
3. cxd5 Nf6
4. dxc5 Qxd5
5. Qxd5 Nxd5
6. e4 Nb4
7. Na3 e5
8. Be3 N8a6
9. Nf3 f6
10. Bxa6 Nxa6
11. Nb5 Bd7
12. Nd6 Bxd6
13. cxd6



Figure S6.3. High denudation rate.

$$\text{ODR} = 9 \text{ units} / 25 \text{ ply} = 0.360 \text{ units/ply}$$

$$\text{PDR} = \text{ODR}/\text{MDR} = 0.360 / 0.909 = 0.396 = 39.6\%$$

EXAMPLES FROM OTHER SYSTEMS

(1) Planck's constant [physics]

Planck's constant h is a well-known constant from physics. It is the ratio $h = E/f$, where E = the minimal increment of energy in a hypothetical electrically charged oscillator, and f = the frequency of that energy. This value is constant throughout our entire physical universe, which is obviously a particularly large and complex system! The value of Planck's constant is:

$$h = 6.626070040 \times 10^{-34} \text{ J}\cdot\text{s}$$

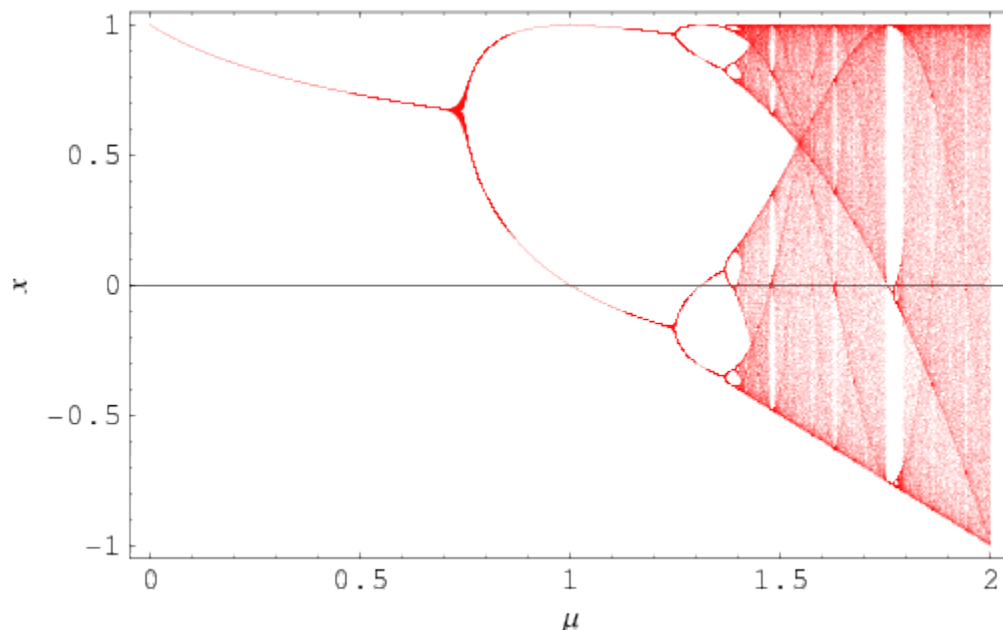
where J = joules and s = seconds. This is an extremely small value because this constant is associated with subatomic phenomena--scales that are far smaller than what humans experience in everyday life. ("Planck constant.")

(2) Feigenbaum constant [mathematics]

An unusual mathematical constant that was discovered in modern times is the Feigenbaum constant:

$$\delta = 4.669201609102990\dots$$

This constant arises naturally when measuring the onset of bifurcations within certain chaotic systems. ("Feigenbaum Constant.") This fact is rather surprising, since chaotic systems by definition are neither random nor periodic, therefore both statistics and classical equations fail to describe such systems accurately. We now know that invariants do exist in such systems, however, some in the geometrical form of strange attractors, some in the numerical form of constants such as the Feigenbaum constant.



The onsets of bifurcation (the forks) along μ are spaced by a factor of δ as a limit.

Principle S7:

Systems typically collapse quickly and spectacularly when stress reaches the critical point.

EXAMPLES FROM CHESS

(1) Combinations

In a reasonably well-played defense, combinations typically arise naturally after a long period of pressure against the losing player. In a poorly-played defense, combinations can arise as the result of even a single error.

In the following game (Richard Reti vs Savielly Tartakower: "Sucker Punch."), Black has made too many errors (especially by moving the queen out too early and falling behind in development with 6...Qa5+, 7...Qxe5), and White is able to launch a combination with a flashy queen sacrifice that wins very quickly. Usually a long period of accumulated pressure is needed in chess games, but this game was chosen here for its short duration.



1. e4 c6 {Caro-Kann Defense.}
2. d4 d5
3. Nc3 dxe4
4. Nxe4 Nf6
5. Qd3 e5 {(Figure S7.1)}
6. dxe5 Qa5+
7. Bd2 Qxe5
8. O-O-O Nxe4 {(Figure S7.2)}
9. Qd8+ Kxd8
10. Bg5+ Kc7
11. Bd8# {(Figure S7.3)}

Figure S7.1. A questionable opening novelty.



Figure S7.2. White to play and win.

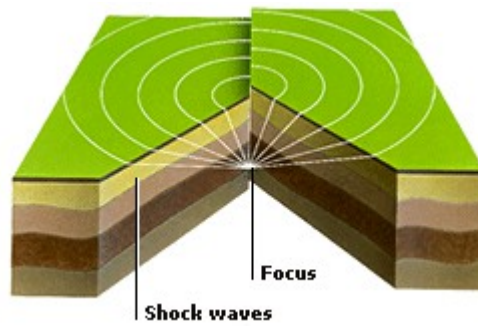


Figure S7.3. White checkmates.

EXAMPLES FROM OTHER SYSTEMS

(2) Earthquakes [geology]

The conditions for earthquakes happen because tectonic plates that have been pushing in different directions have regions that hold the edges of those plates together despite the motion of rest of the plates, a condition that causes great stress on the rocks preventing the natural plate motion. After enough time, usually years, the rocks at those highest stress points suddenly break from the prolonged pressure, which allows the plates to move suddenly, which in turns causes a shaking motion to radiate out from the slippage point, which is felt as the ground moving, called an earthquake. (Fryer) As in chess, one can determine that high pressure exists in the tectonic plate system, but predicting exactly when the breaking point is reached is extremely difficult.



Principle S8:

One design alteration tends to force another design alteration.

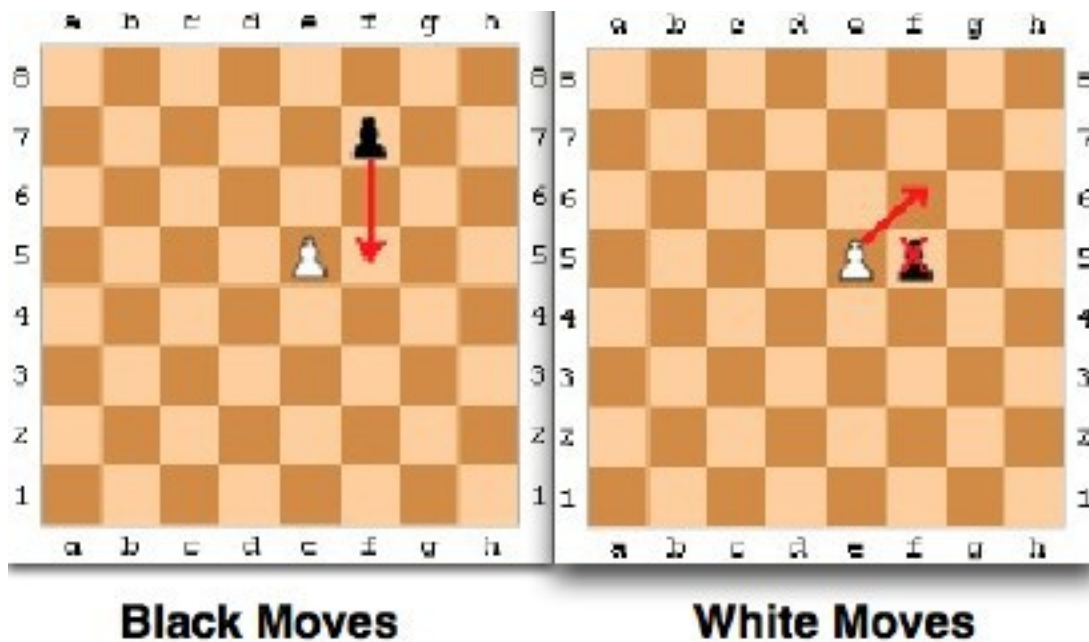
EXAMPLES FROM CHESS

(1) Creation of the castling rule

Chess is the only chess-like game (games like shogi, xiangqi, and checkers) that has a piece with the powers of the modern queen. When the modern queen and bishop were added to chess, the presence of such powerful, long-range pieces on the board was unprecedented and it made the kings highly vulnerable in their central locations early in the game. In order to restore the kings to their former safety, a compensation rule was forced to be added: the mechanism of castling. (“Castling.”) In summary, one alteration to the rules of chess forced another alteration to compensate for the first alteration.

(2) Creation of the *en passant* rule

Chess used to be a slower game because in the earlier forms of the game, pawns could only move one square at a time. To speed up the game a new rule was created that allowed pawns to move two squares, but only on their first move. However, this change caused a new problem of unfairness in that an opponent's pawn adjacent to the target square of an emerging pawn would never get a chance to capture the pawn emerging in its initial two-square advance. To compensate for this problem, another exception had to be created to the chess rules that allowed the opponent's pawn to capture such an emerging pawn. This new type of capture was called *en passant*, and the capture allowed by this rule essentially pretended that the emerging pawn had advanced only one square, so that the capturing pawn would land in the location it would have landed during a normal diagonal capture after a one-square advance. (“En passant.”) This looks confusing to beginners because the capturing pawn consequently lands on an unoccupied square, much like a capture in checkers, a type of capture unknown in the rest of chess.



Oddly, the pawn capturing via *en passant* lands on an empty square!

EXAMPLES FROM OTHER SYSTEMS

(1) Rocket Rods [engineering]

The Rocket Rods were a Disneyland attraction that opened in 1998. These were relatively high-speed vehicles that ran atop the structure in Tomorrowland that was formerly used by the slow-moving PeopleMover vehicles. The Rocket Rods attraction closed only two years after opening, however, because the change to a higher speed put more stress on the existing elevated track structure, as well as on the vehicles themselves. The track structure had not been designed for such fast vehicles, so the track became damaged and would have been so costly to redesign and/or replace that it was simpler just to shut the attraction down, which is what was done. (“Rocket Rods.”)



Disneyland's Rocket Rods on the elevated structure they permanently damaged.

(2) Adding a second floor to a house [engineering]

Adding a second floor to a house causes a “ripple effect” whereby extensive, unexpected modifications in other parts of the house must be done: structural work, mechanical work, and finishes. Since a one-story house wasn't designed for the extra weight of a second store, the modifications will include adding steel and plywood at the main connections and at the foundation. (Higuera 2013)

Principle S9:

Complex systems often exhibit synergy. Synergy is a situation where an effect from combined forces occurs that is stronger than a linear combination of those component forces would be.

EXAMPLES FROM CHESS

(1) Doubled rooks

As Chernev likes to point out repeatedly, the power of doubled rooks is more than double their single power. In the following game (Chernev 1998, pp. 148-156) Van Vliet as Black doubles rooks on the c-file, unopposed, which forces White to struggle for many moves to free his pieces without material loss, but White is forced to lose so many tempi in doing so that White must then enter into a losing king-pawn endgame.

1. d4 d5
2. e3 c5
3. c3 e6
4. Bd3 Nc6
5. f4 Nf6
6. Nd2 Qc7
7. Ngf3 cxd4!
8. cxd4 Nb4!
9. Bb1 Bd7
10. a3 Rc8
11. O-O Bb5
12. Re1 Nc2!
13. Bxc2 Qxc2
14. Qxc2 Rxc2
15. h3 Bd6
16. Nb1 Ne4!
17. Nfd2 Bd3
18. Nxe4 Bxe4
19. Nd2 Kd7
20. Nxe4 dxe4
21. Rb1 Rhc8 {(Figure S9.1)}
22. b4 R8c3
23. Kf1 Kc6
24. Bb2 Rb3
25. Re2 Rxe2



Figure S9.1. Black doubles rooks on the c-file.

26. Kxe2 Kb5
27. Kd2 Ka4
28. Ke2 a5!
29. Kf2 axb4
30. axb4 Kxb4
31. Ke2 Kb5!
32. Kd2 Ba3
33. Kc2 Rxb2+!
34. Rxb2+ Bxb2
35. Kxb2 Kc4
36. Kc2 b5 {0-1. Van Vliet - Znosko-Borovsky.
Ostend 1907. Analysis:}
37. g4 b4
38. h4 b3+
39. Kd2 b2
40. Kc2 b1=Q+
41. Kxb1 Kd3
42. Kc1 Kxe3
43. Kd1 Kf2
44. f5 e3
45. fxe6 e2+
46. Kc2 fxe6
47. Kd3 e1=Q
48. Kc4 Kg3

EXAMPLES FROM OTHER SYSTEMS

(1) Flying geese [animal behavior]

When geese fly in a v-formation, they can fly 70% farther because the drag on each goose is reduced due to the collective action of the flock. (Wilson)



Flying snow geese.

Principle S10:

In complex systems there often exists an equivalence of energy and mass, such that one can be converted to the other, although analogous concepts might be involved such as power instead of energy, or material instead of mass. Also, conversion can occur between different *types* of energy.

EXAMPLES FROM CHESS

(1) Conversion

“Conversion” is a chess term that means chess material, which is analogous to mass, is being converted to a positional advantage, which is analogous to energy, or vice versa. (Spielmann 1995, p. 40) There does not exist any standard way to force such a conversion; a player must be alert to when an opportunity arises naturally, then figure out which move causes the conversion.

(2) Types of positional advantages

Less well documented in chess is that one type of positional advantage can be converted to another type of positional advantage. Some types of positional advantages that can be interconverted are material, space, mobility, development, and time.

In the following game (Fischer 1972, pp. 234-239), Fischer as White gains a spatial advantage, then notices that Black has a back rank weakness that can be exploited by capturing a pawn with his queen without Black being able to capture back because Black would get mated on the back rank. That one oversight by Black cost him a pawn, which in turn cost him the game since in the endgame White's king is free to roam while Black's king is confined to the back rank by White's rook on the 7th rank, which means White can escort his extra pawn to promote to a queen, which will give White an overwhelming advantage in material.

1. e4 e5
2. Nf3 Nc6
3. Bb5 {Ruy Lopez.} a6
4. Ba4 Nf6 {Morphy Defense.}
5. O-O Be7 {Closed Defense.}
6. Re1 b5
7. Bb3 d6
8. c3 O-O
9. h3 Na5
10. Bc2 c5
11. d4 Nd7 {Keres Variation.}
12. dxc5 dxc5
13. Nbd2 Qc7
14. Nf1 Nb6
15. Ne3 Rd8



Figure S10.1. White has a spatial advantage.

16. Qe2 Be6
17. Nd5 Nxd5
18. exd5 Bxd5
19. Nxe5 Ra7
20. Bf4 Qb6
21. Rad1 g6
22. Ng4 Nc4
23. Bh6 Be6
24. Bb3 Qb8
25. Rxd8+ Bxd8
26. Bxc4 bxc4 {(Figure S10.1)}
27. Qxc4! {(Figure S10.2)} Qd6
28. Qa4 Qe7
29. Nf6 Kh8
30. Nd5 Qd7
31. Qe4 Qd6
32. Nf4 Re7
33. Bg5 Re8
34. Bxd8 Rxd8
35. Nxe6 Qxe6
36. Qxe6 fxe6
37. Rxe6 Rd1
38. Kh2 Rd2
39. Rb6 Rxf2
40. Rb7 Rf6
41. Kg3 {1-0. Robert James Fischer vs Paul Keres. Curacao Candidates (1962). {(Figure S10.3)}}



Figure S10.2. White converts to a material advantage.



Figure S10.3. White wins.

EXAMPLES FROM OTHER SYSTEMS

(1) $E = mc^2$ [physics]

In physics, energy (E) and mass (m) are interconvertible per Einstein's famous formula $E = mc^2$. Mathematically the two measurements are proportional to each other, where the constant of proportionality c equals 2.99792458×10^8 m/s. Although in physics it is difficult to convert between energy and mass, this large constant of proportionality means that, with proper materials and equipment, huge amounts of energy can be released from a small amount of mass, which is why nuclear weapons are so powerful.



In physics a little mass converts to a lot of energy.

(2) Types of energy [physics]

Forms of energy can be converted between one another. For example, a light bulb is an example of a device that converts electrical energy into light energy.

Principle S11:

By their very definition, heuristics (rules of thumb) are only rough guidelines that do not hold true all the time. Overreliance on heuristics as absolute truth can cause extremely damaging consequences because a person acting upon a heuristic in one of the cases when it does not apply will be acting on an untruth.

EXAMPLES FROM CHESS

(1) “Passed pawns must be pushed!?”

A well-known heuristic in chess is “Passed pawns must be pushed!”, meaning that when one has a passed pawn, usually the best move is to push it forward toward promotion. However, this is only a heuristic, so it is not reliable 100% of the time. This heuristic ignores the specific position, and also the timing of such a push, which sometimes are critical considerations for determining the best move at any given position.

In the following game (Tal 1997, pp. 49-53), Tal as White pushes his far-advanced pawn via 38. h7?, but in his book he laments his mistake, since first checking with his rook (38. Rb7+!) would have won the game instead of theoretically losing it. Fortunately for Tal, his opponent blundered at move 41, which allowed Tal to win, but that does not change the fact that his actual move based on the passed pawn heuristic was a mistake that would normally have cost him the game.

1. e4 e5
2. Nf3 Nc6
3. Bb5 {Ruy Lopez.} a6
4. Ba4 Nf6 {Morphy Defense.}
5. O-O Be7 {Closed Defense.}
6. d4 {Centre Attack.} exd4
7. e5 Nd5
8. Nxd4 Nxd4
9. Qxd4 Nb6
10. Qg4!? Nxa4
11. Qxg7 Rf8
12. Bh6 d5
13. Qxh7 Bd7
14. Nd2 Bb5
15. c4! dxc4
16. Ne4 Nxb2!
17. Bxf8 Bxf8
18. Nf6+ Ke7
19. Rfe1 Qd4
20. Re4 Qc5
21. e6! Kd6
22. e7! Kc6
23. Qxf7 Bxe7
24. Rxe7 Kb6
25. Rxc7! Qd4
26. Rxb7+ Ka5
27. Qd5?? Rd8
28. Qxd4 Rxd4
29. h3 c3
30. Rc1 Kb4
31. Re7 Bc4
32. Ne4 Rd1+
33. Rxd1 Nxd1
34. Nxc3 Nxc3
35. h4 Bxa2
36. h5 a5
37. h6 Bb1 {(Figure S11.1)}
38. h7? {(Figure S11.2)} Bxh7
39. Rxh7 a4
40. g4 a3
41. Ra7?? Na4??
42. Rb7+ Ke3
43. Rb1 Kc2
44. Re1 Nc3
45. g5 a2
46. g6 Nb1
47. g7 a1=Q



Figure S11.1. The wrong time to use the heuristic.



Figure S11.2. What White actually played.



Figure S11.3. What White should have played.

48. g8=Q Kd2
 49. Qe6 Qg7+
 50. Kf1 Nc3
 51. Qe3+ Kc2
 52. Rc1+ Kb3
 53. Qxc3+ Qxc3
 54. Rxc3+ Kxc3
 55. Ke2 Ke4
 56. Kf3 Ke5
 57. Kg4 Kf6
 58. Kf4 {1-0. Tal - Straume. Riga
 Championship 1953.}



Figure S11.3. The winning position White would have had.

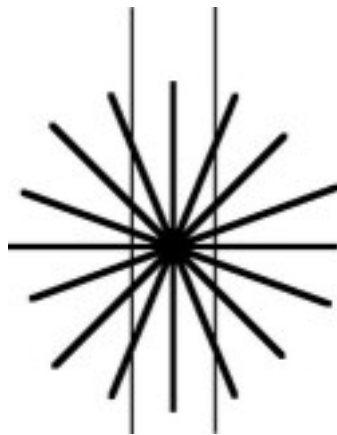
{Analysis:}
 38. Rb7+! {(Figure S11.3)} Nb5
 39. h7 Bxh7
 40. Rxh7 a4
 41. g4 a3
 42. Kg2 a2
 43. Rh1 Nc3
 44. Ra1 Kb3
 45. g5 Kb2
 46. Rxa2+ Kxa2
 47. g6 Nd5
 48. Kf3 Kb3
 49. Ke4 Kc4
 50. Ke5 Ne7
 51. g7 Kc5
 52. f4 {(Figure S11.4)}

EXAMPLES FROM OTHER SYSTEMS

(1) Optical illusions [cognitive science]

Optical illusions are created because the brain relies on shortcuts (heuristics!) to reduce the amount of processing it must do in order to interpret image data entering the eyes. These shortcuts make the brain faster than a computer when recognizing images, but also less accurate than a computer, especially when processing numbers.

The following is one of many optical illusions, this one called the Hering illusion. (“Hering illusion.”) The two parallel lines appear bent, but they are actually straight, which can be confirmed by overlaying a straight edge along one of the parallel lines in the image.



The Hering Illusion.

Principle S12:

The edge of a bordered system often alters the normal behavior of any components that come near that edge.

EXAMPLES FROM CHESS

(1) Rook pawn endings

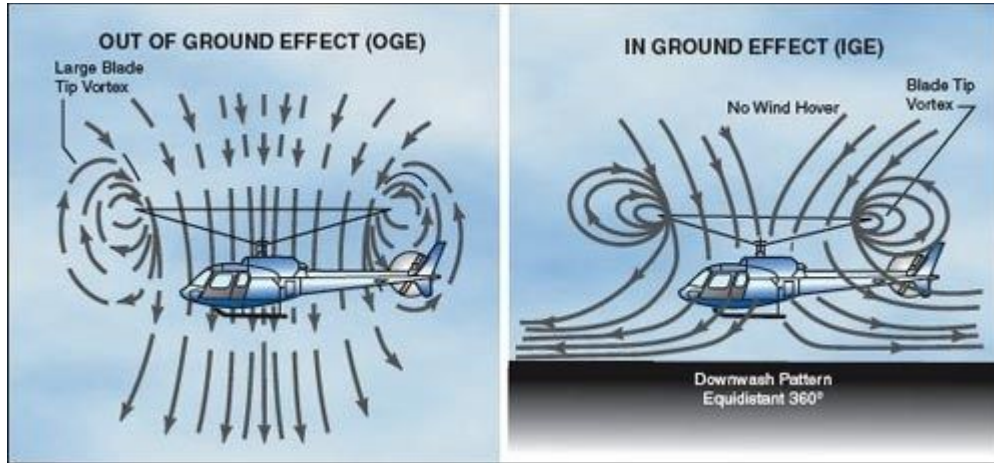
In an endgame with only two kings and a pawn left, in most cases the side with the pawn can win if its king can get in front of the pawn and get the opposition. This is because the opposition situation will force the opponent's king to move to one side of the pawn, which allows the superior side to escort the pawn to promotion by moving to the other side of the pawn.

There is one exception to this general rule, however: if the pawn is on the edge, the side with the pawn cannot force a win, therefore such a position will end in a draw. This is because when the pawn is on the edge, the king with the pawn cannot move around to the other side of the pawn, but instead must move to the same side to which the fleeing king had been forced, whereupon the best that the superior side can do is to move his king into the corner, pull the pawn up behind the king, and stalemate himself! A stalemate is still considered a draw.

EXAMPLES FROM OTHER SYSTEMS

(1) Ground effect [aviation]

When a plane, helicopter, or gyrocopter lands, there exists a natural cushioning effect as the aircraft nears the ground because the wind directed downward from the aircraft has a surface on which to rebound, and that rebounding air creates extra lift that did not exist at high altitude. This phenomenon is called "ground effect" in aerodynamics. It sometimes seems to pilots when landing that the aircraft is floating. ("Ground effect (aerodynamics).") A skilled gyrocopter pilot, for example, upon shutting off his engine shortly before landing, can autorotate his craft into a silent and incredibly gentle touchdown, almost like a feather landing on a pillow.



Principle S13:

The earlier a distortion appears in an expanding system, the more damaging its results will be on the system later on.

EXAMPLES FROM CHESS

(1) Weak opening moves

In the following game (“Kalezic (2396) vs. Radonjic.”), Black plays the Greco Defense, which starts weakly very early by having the queen (via 2...Qf6) block the normal development of the king's knight to f6. There follows a situation where Black is constantly on the defensive, such as having his queen pushed around (first 5. e5 Qe6, then 15. Nd4 Qe7, then 16. Nf5 Qe6), being forced to block more of his own pieces from developing properly (7...Nd7), being forced to put other pieces on poor squares (11...Ng6, 23...Ng7), being subjected to a kingside attack (13. h4, 14. h5, 18. hxg6), being forced to retreat pieces to the back rank (14. Ngf8), being forced to weaken his kingside further by advancing pawns to avoid mate (17. Qg5 g6), and finally being forced to lose his queen via knight fork on only the 27th move (26. Nf7+ Kg8 27. Nxf7). The general flow of this ill-fated game demonstrates how an early weak move usually leads to an early loss, plus it illustrates the additional principle that one problem tends to cause another, in unending succession.

1. e4 e5 {Double King's Pawn Game.}
2. Nf3 Qf6 {Greco Defense. **(Figure S13.1)**}
3. Nc3 c6
4. d4 exd4
5. e5 Qe6
6. Qxd4 d5
7. Be3 Nd7
8. O-O-O Bc5
9. Qd2 Bxe3
10. Qxe3 Ne7



Figure S13.1. A weak move at move #2.

11. Bd3 Ng6
 12. Rde1 O-O
 13. h4 Re8
 14. h5 Ngf8
 15. Nd4 Qe7
 16. Nf5 Qe6
 17. Qg5 g6
 18. hxg6 fxg6
 19. f4 Nc5
 20. Nh6+ Kh8
 21. Be2 Qe7
 22. Qg3 Nce6
 23. Kb1 Ng7
 24. Bd3 Nge6
 25. f5 Qg5
 26. Nf7+ {1-0. Kalezic (2396) vs. Radonjic.
 Herceg Novi 2007. Analysis:} Kg8
 27. Nxg5 {(Figure S13.2)}



Figure S13.2. Black will lose his queen at move #27.

EXAMPLES FROM OTHER SYSTEMS

(1) Flower buds [botany]

Once when I was a boy I wandered around the flower gardens of our back yard with a pin and maybe out of dull amusement I poked holes in various flower buds, especially those of California Poppies. A few days later when the flowers bloomed I saw the result of the damage I had caused: the petals I had poked just before they had emerged had small, clean-cut holes in them, but petals I had poked that had been inside tightly packed, very immature buds bloomed with large, irregular holes in the petals. I therefore learned the lesson very early in life that the earlier damage was caused, the worse the resulting damage would be.

CONCLUDING REMARKS

Omitted topics

Regretfully, many important topics had to be omitted from this document due to focus and space limitations. Some of these omitted topics are:

- (1) Additional games to illustrate a given chess principle.
- (2) Additional topics in chess that do not have a close analog in real life.
- (3) Additional topics in warfare that do not have a close analog in chess.
- (4) Very important principles of morality, psychology, and systems that negate many warfare principles.
- (5) Many additional topics in real life that do not have a close analog in chess.

Intended audiences

I believe this document would probably be most useful to the following groups of people:

- (1) People who want to learn chess for what it can teach about real life and/or warfare, but who lack the extensive free time required to gain those deeper insights by playing hundreds of games.
- (2) People who intend to learn chess but would like to see the big picture first, in a top-down approach to learning the game. This approach would show the end result first, to provide a feel for where the chess student will be headed, and a feel for whether that student will likely enjoy chess.
- (3) Young students of any age or discipline who are interested in or could benefit from learning some general principles of systems and life in general. This document provides an organized sampling of wisdom useful to all endeavors from art to science.
- (4) Beginning chess players who want to learn a few intermediate level tricks that are not explicitly taught in any book. This document provides only a sampling of such tricks, however.
- (5) Philosophers, computer scientists, psychologists, or similar scientific people interested in developing a new science of “synesology.” This document provides one of the first samplings of one possible organization of a compendium of wisdom.
- (6) Chess authors who want some new ideas, especially mathematically-based ideas, to include in a new type of opening book, or who are seeking new types of representation.
- (7) Skeptical young people (under 30 years old) who do not believe that a person can master life in the sense of understanding how all important subjects are connected: religion, politics, science, art, games, warfare, mathematics, logic, physics, chemistry, psychology, philosophy, emotions, ethics, etc.

Caveats

Chess does not teach us everything about real life. Chess is a limited system of purely warfare-like activity with nonliving units, a system that does not interact with the real world, therefore its single goal of winning (or at least not losing) does not involve real suffering, real death, or very long-term effects (emotional, health, environmental, etc.) that typically result from disregard for living organisms. Also, chess is very unlike nature in that it contains only destructive activity, which is contrary to the natural activities of charity, compromise, symbiosis, or overall societal/species improvement found throughout nature and all of its living communities. Therefore one must always be careful not to excessively carry the principles of chess into one's own life, especially with regard to ethics.

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