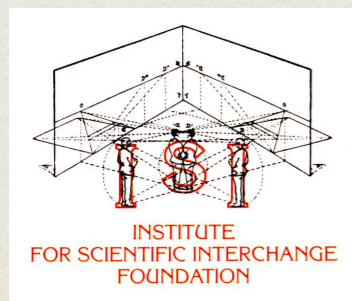


# INTUITION AND CREATIVITY IN CHESS GAMES

*B. Monechi, Vito D. P. Servedio, P. Gravino and V. Loreto*



SAPIENZA  
UNIVERSITÀ DI ROMA

# Introductory material

## Who am I?

Amateur player, no tournaments, no rating

## CHESS

Chess is a *finite zero-sum perfect information* game  
it can yield three possible results: **white wins, black wins, draw**

Usually, both players are under **time constraints**

A typical chess game can be divided into three phases:

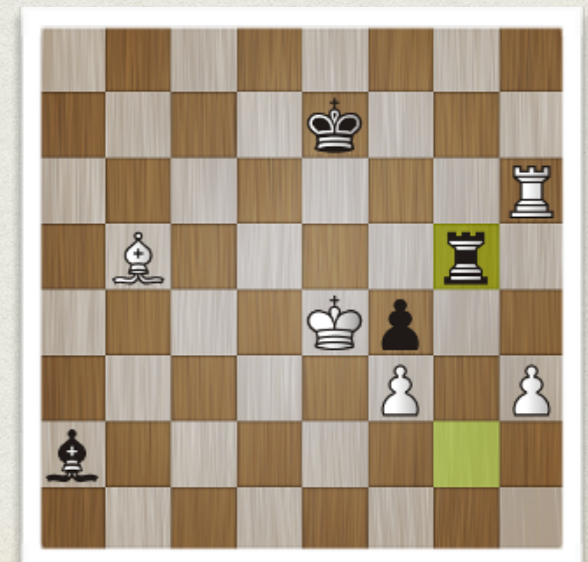
### OPENING



### MIDGAME



### ENDGAME



# What is creativity in chess?

## CHESS



Chess compositions

New opening lines

Strategy traps

## LANGUAGE



Poetry

New novels (e.g., H.Potter)

Plot twists - coup de théâtre

# Chess compositions

## Kreyon Open Challenge of chess composition

constraints:

$$2K + 1R + 2N + 2B + 4P =$$



degrees of freedom:

- piece of any colour,
- remove a piece at choice,
- add a piece at choice

19 valid compositions submitted

present to J. Polgár

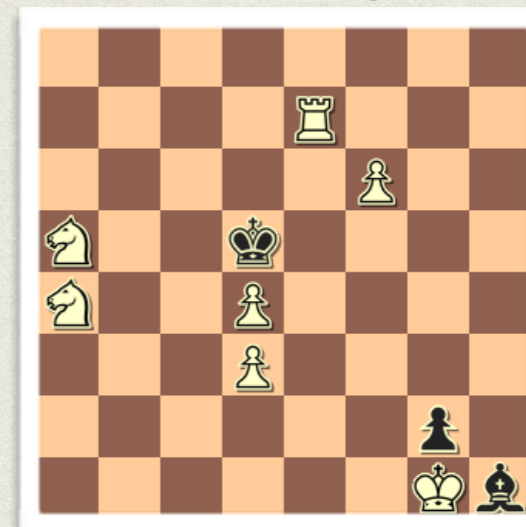


w#2 (A. Misericordia 2015)



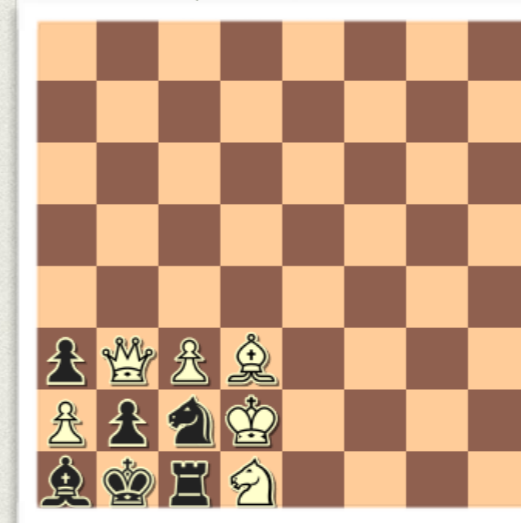
w#3 (A. Misericordia 2015)

winner



w#4 (A. Misericordia 2015)

honorable mention



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Judit Polgár

Head of the  
evaluation panel

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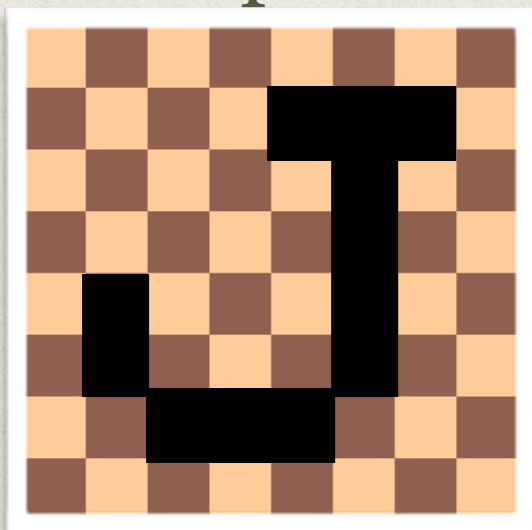


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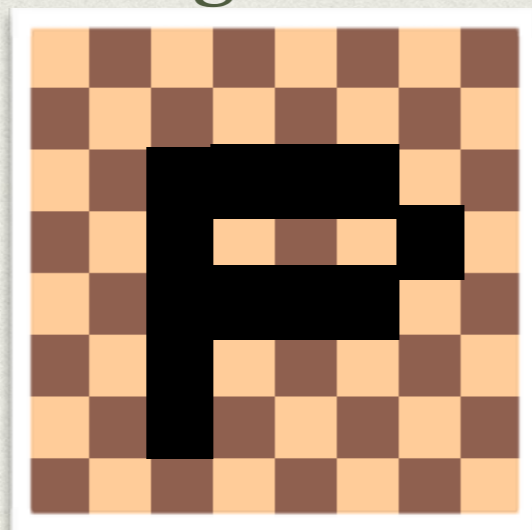
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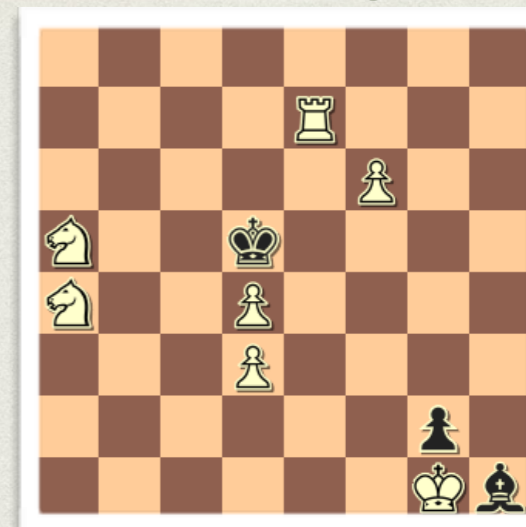


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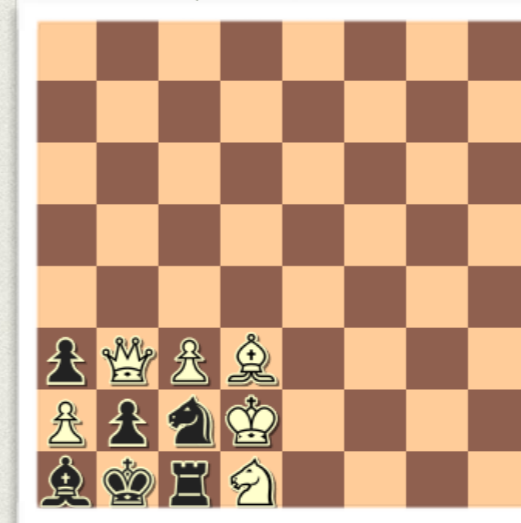
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# Creativity in a chess game (is there any?)

## Lots of data:

- millions of games
- pondering times (FICS) <http://www.ficsgames.org/>
- ELO (ability) of players

## Huge nr of configurations

**creativity in openings  
(explore the adjacent possible)**

*Zipf's Law in the Popularity Distribution  
of Chess Openings*

Bernd Blasius and Ralf Tönjes

Phys. Rev. Lett. 103, 218701 (2009)



Karjakin-Carlsen, WC2016 game 7  
Slav defence, 10...Nc6

**creativity in midgame?**

Judit Polgár:

*“Chess is 30% to 40% psychology”*

## Chess game phases:

1. opening (~20 moves = 40 plies)
2. midgame
3. endgame (few pieces on the board)



**Nigel Short**

@nigelshortchess

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10...Nc6 diverges from Capablanca-Rubinstein, Moscow 1925 -  
off the top of my head #CarlsenKarjakin

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Byrne-Fischer, NYC 1956  
Grünfeld Defence, 17.Kf1

[https://en.wikipedia.org/wiki/The\\_Game\\_of\\_the\\_Century\\_\(chess\)](https://en.wikipedia.org/wiki/The_Game_of_the_Century_(chess))

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# Can chess engines help?



Rank	Name	Rating			Score	Average Opponent	Draws	Games	LOS
		Elo	+	-					
1	<b>Stockfish 8 64-bit 4CPU</b>	3475	+17	-17	78.7%	-202.2	39.5%	1304	67.2%
2	<b>Houdini 5.01 64-bit 4CPU</b>	3469	+21	-20	78.2%	-204.0	38.4%	923	99.9%
3	<b>Komodo 10.2 64-bit 4CPU</b>	3426	+18	-18	70.9%	-145.0	44.4%	1094	100.0%

## Stockfish

<https://stockfishchess.org/>

<https://github.com/official-stockfish/Stockfish>

chess engines evaluate **positions** (not moves) and suggest (their) best continuation

evaluations are given in **centipawns** (cp)  
 positive evaluations mean that white has advantage  
 negative evaluations mean that black has advantage

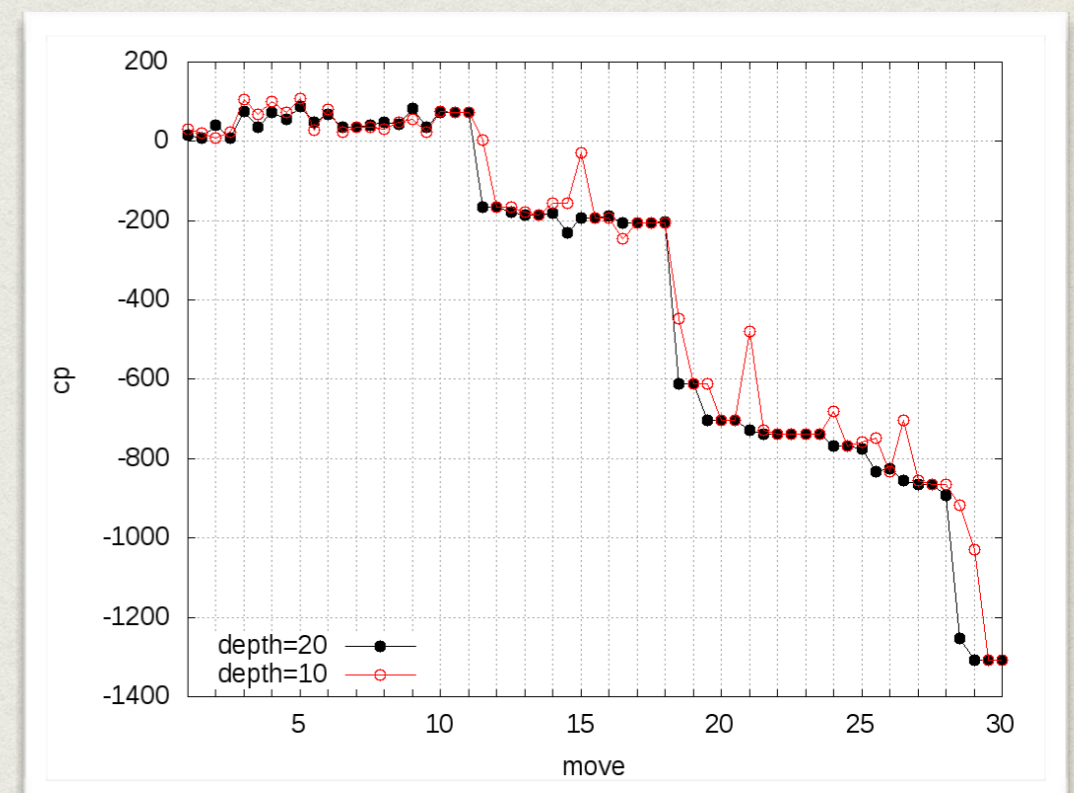
at present, engines **cannot** assess whether a move is a good move, but can quantify bad moves

**IDEA!** compare engine output at different depths!

Player	$P(win)$	$P(draw)$	$P(signal)$	$P(wins signal)$	$P(wins no-signal)$	$\langle r \rangle$
Caruana	0.419	0.378	0.087	0.884	0.375	0.818
Carlsen	0.362	0.398	0.079	0.978	0.309	0.844
Caruana's Opponents	0.203	0.378	0.043	0.709	0.181	0.772
Carlsen's Opponents	0.239	0.398	0.038	0.681	0.222	0.83

## human players

Rank	Name	Title	Country	Rating	Games	B-Year
1	<u>Carlsen, Magnus</u>	g	NOR	2853	0	1990
2	<u>Caruana, Fabiano</u>	g	USA	2823	9	1992
3	<u>Vachier-Lagrave, Maxime</u>	g	FRA	2811	0	1990



Byrne-Fischer, NYC 1956



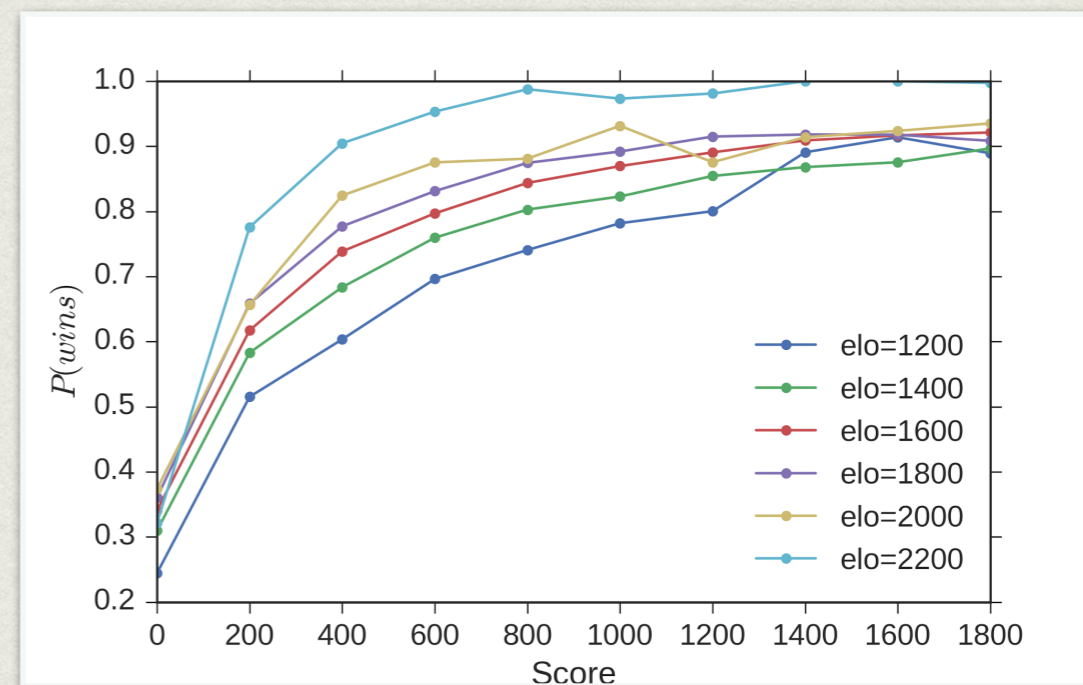
# Analysis of FICS database

**ELO:** measures the relative skill level of players

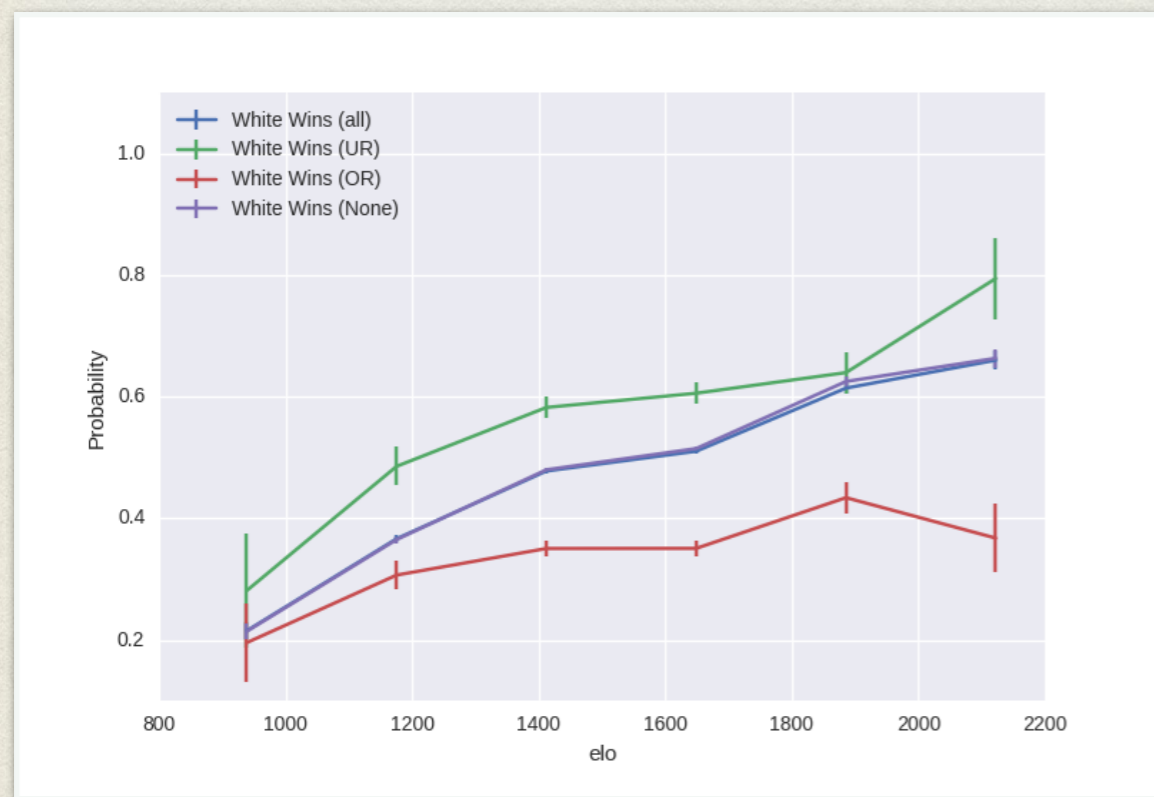
only games with  $|\text{delta ELO}| < 100$  were considered

**UR:** underrated move (looks bad, it's not)

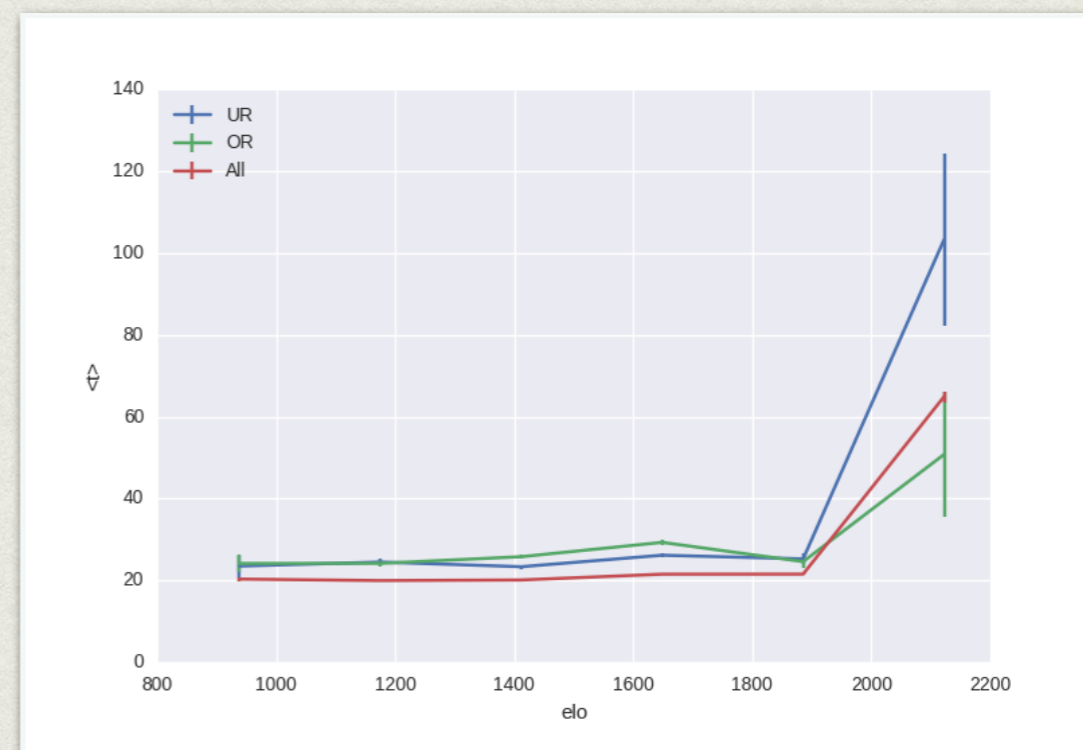
**OR:** overrated move (looks good, it's not)



estimated probability to win when a position with given score appears



probability that white with given ELO wins



pondering time (sec) vs ELO

# What did we learn?

The game of chess hosts creativity at different levels:

- chess compositions (aesthetic beauty)
- exploration of new opening schemes (rare nowadays)
- strategical traps

We possibly found the way of characterising strategical traps from a pool of actually played games.

The enhanced pondering time of Masters in correspondence of these peculiar positions points toward a mechanism of intuition and creativity, which distinguish them from amateur players.

END