The **chess** food web

Human-played games: *Lichess* database (1.47 billion finished games, 2013–2024; 11 TB data).

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The **food web**: an ecosystem's **predator-prey** links.

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(Big) data mining, also by players' expertise.

Capture occurrences per 1,000 games

	🨋	🨎	🨍	🨌	🨏
🨋	2842	577	610	104	87
🨎	1149	710	518	208	129
🨍	936	957	692	245	126
🨌	1060	270	327	731	200
🨏	1362	429	482	328	382
🨐	369	110	167	159	82

Attacker (rows) / Victim (columns)

Distinct piece capture probability per game

	🨋	🨎	🨍	🨌	🨏
	0.022	0.018	0.019	0.0033	0.0055
	0.036	0.089	0.065	0.026	0.032
	0.029	0.12	0.086	0.031	0.031
	0.033	0.034	0.041	0.091	0.05
	0.085	0.11	0.12	0.082	0.19
	0.023	0.028	0.042	0.04	0.041

Pairwise **attack-to-victim capture data** (not symmetric, and the diagonal is meaningful). The king cannot be captured. (left) per piece type, (right) per distinct piece from a type.
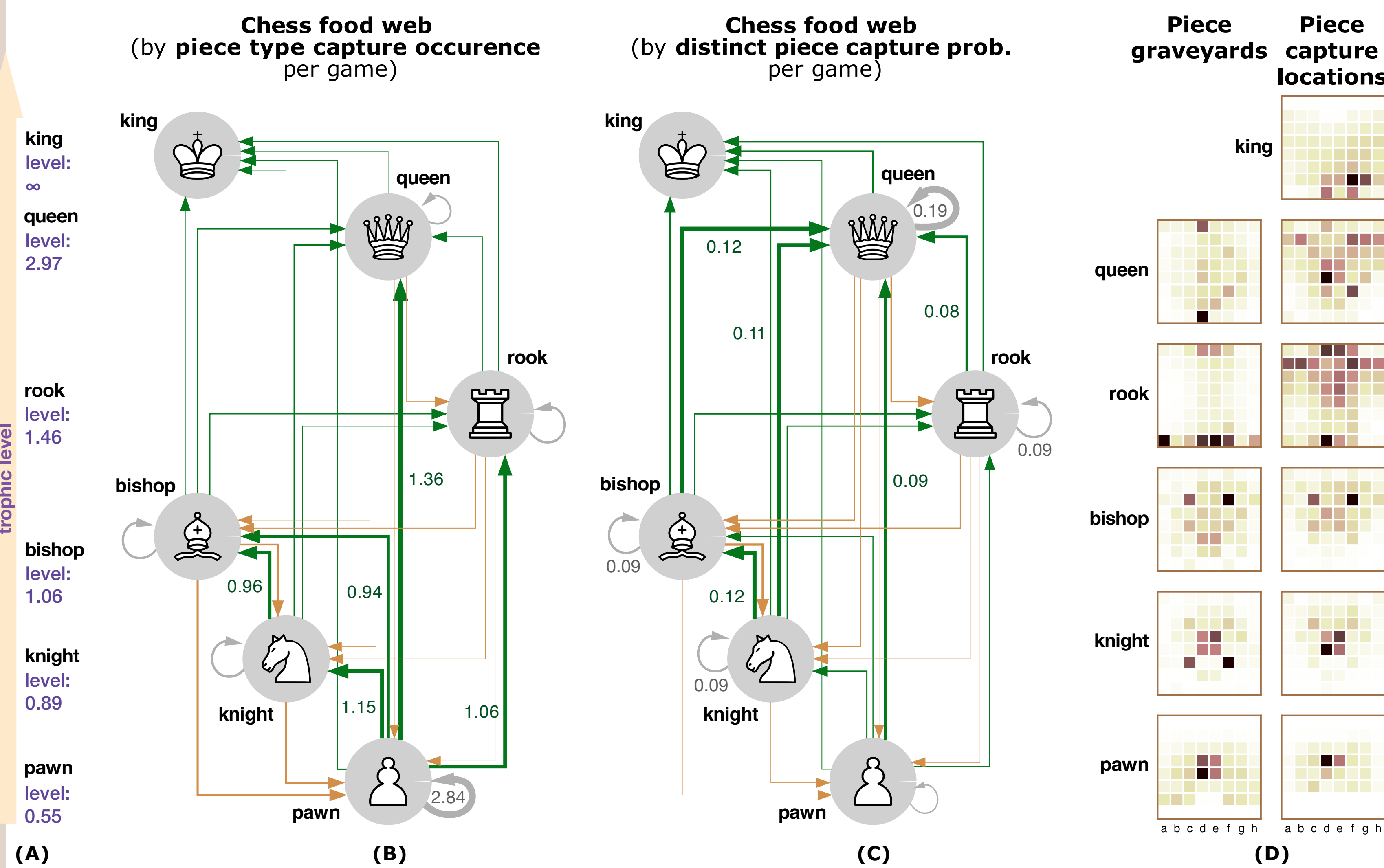
💡 **Trading** pieces is fairly common (some link symmetry). The queen trades often, and is a strong piece.

Traditional point value (TPV) vs. capture point value (CPV)

Legend: TPV, CPV (all), CPV (beginner), CPV (expert)

x-axis: pawn, knight, bishop, rook, queen

(**TPV**: Traditional Point Value of chess pieces (1763, Giovanni Lolli et al.) Still in use.)
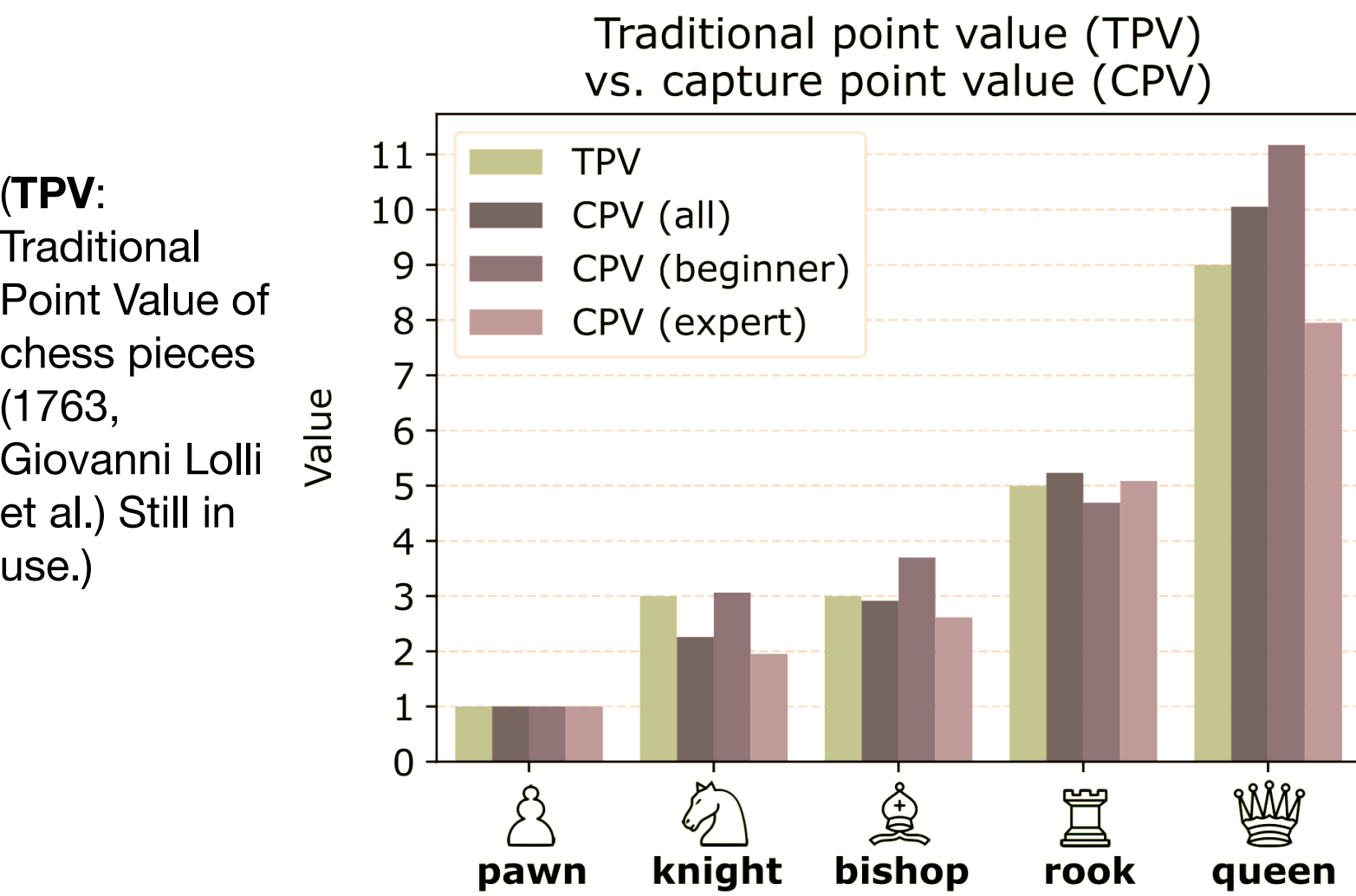
CPV: Capture Point Value (new!). Recursively sets the piece value based on the value of the piece types it captured.

💡 CPV much higher for the queen (except to experts) and lower for the knight (except to beginners) — compared to TPV and the AlphaZero valuation.

(Beginner: 5th pct. of Elo rating. Expert: 95th.)

12-century Scandinavian rook or pawn chess piece. The Met Museum, accession number 2013.621.

Chess food web (by **piece type capture occurence** per game)

trophic level (arrow up)

king level: ∞
queen level: 2.97
rook level: 1.46
bishop level: 1.06
knight level: 0.89
pawn level: 0.55

(A)

(B) — labels: 1.36, 0.96, 0.94, 1.15, 1.06, 2.84

Chess food web (by **distinct piece capture prob.** per game)

(C) — labels: 0.19, 0.12, 0.11, 0.08, 0.09, 0.09, 0.12, 0.09

Piece graveyards / Piece capture locations

king, queen, rook, bishop, knight, pawn

a b c d e f g h

(D)

(A) Trophic levels: ratio in- to out-strength

(B-C) Chess food web. Weighted directed graph with (self-)cycles. (Only the largest weights are labelled.) Energy flows upwards. The higher the in-strength, the more this piece is in an attacker position; the higher the out-strength, the more this piece is a victim.

💡 In chess, **no primary producers** (trophic level 0). The lower trophic ranks are to an extent competitive and egalitarian: producers not clearly distinguishable from consumers. Every chess piece type is **omnivorous** and a **cannibal**. Besides the top predator, **a tangled web of omnivores**, like some marine ecosystems.

💡 The queen is the **top predator**.

(D) Graveyards and capture locations for white (down).

💡 Rook's hunting area (rank 7): different than its graveyard. The bishop is traded on two squares (rank 5, cf.)

💡 Most pieces are captured on squares that they can reach within one move.

(This is not yet a paper.)

Interested in modelling human-played games as food webs? *Contact*:

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