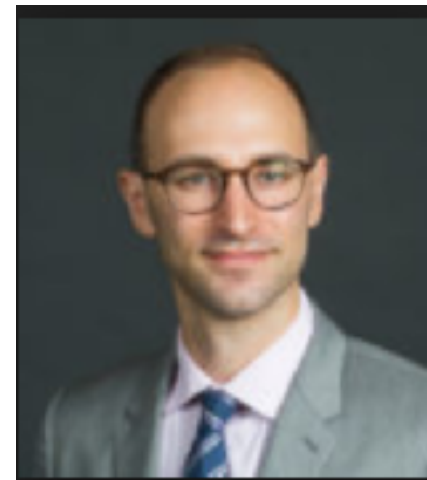


Personal Bests as Reference Points

Ashton Anderson
University of Toronto



Etan Green
Wharton

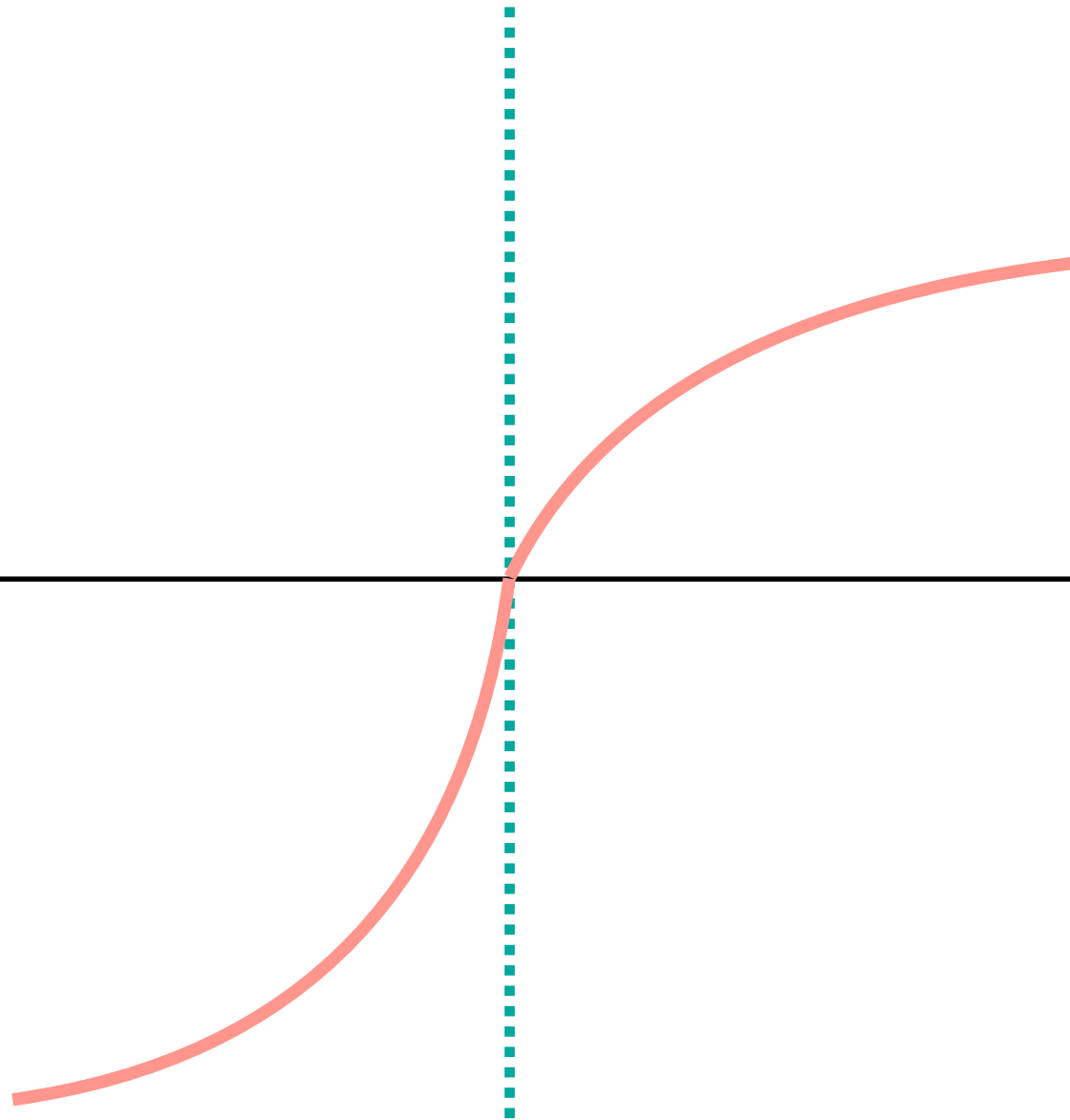


BEAR Research Retreat 2018
Toronto

Losses

Gains

Reference Point



Where do reference points come from?

Prior Work

Where do reference points come from?

- Goals provide reference points [Heath, Larrick, Wu, 1999]
- Goals tend to be externally generated
(e.g. round numbers [Pope & Simonsohn, 2010])
- Reference points can be internally generated
(e.g. expectations [Mellers et al., 1997])

This Work

Personal bests are an internally generated goal

This Work

Personal bests are an internally generated goal

More effort when just short of a personal best

Less motivation after setting a new personal best

Personal Bests

- Athletes and fastest times or best statistics
- Students and test scores
- Teachers and course evaluations
- Real estate agents and commissions
- Salespeople and monthly records
- Traders and portfolio valuations



Personal Bests

“There is nothing noble in being superior to your fellow man; true nobility is being superior to your former self.”

— Ernest Hemingway

Difficulties

Personal bests cannot be randomly assigned

Difficulties

Personal bests are necessarily rare

Solution

The screenshot displays the BabasChess application interface. The main window shows a chessboard with pieces and a move list on the right. The move list shows moves 1 through 29, with the final move being 29. ♖h8#. The console window on the right displays game logs, including the FICS web page URL, a list of new news items, and a message from wamer(TD) about a tournament. The info window at the bottom right shows a list of players with their ratings and names.

Move List:

1. e4 c5
2. ♘f3 d6
3. d4 cxd4
4. ♘xd4 ♘f6
5. ♘c3 a6
6. ♗g5 e6
7. f4 ♗e7
8. ♖f3 ♖c7
9. O-O-O ♘b4
10. ♘b1 b5
11. ♗d3 ♗c7
12. ♗he1 ♗d4
13. ♘ce2 ♘c5
14. g4 ♘f6e4
15. ♖e2 ♘g5
16. ♖g5 ♗e5
17. ♗xh3 e5
18. ♘f5 O-O
19. ♗eg3 ♗f5
20. ♘h5 ♗f8
21. ♖h3 e4
22. ♗h3 ♗c8
23. ♗e1 d5
24. ♖h4 d4
25. ♘f6+ gxf6
26. ♗h5 h6
27. ♘h6+ ♗xh6
28. ♖xh6 d3
29. ♖h8#

Console (connected):

```
-----
FICS web page: http://www.freechess.org - add a link to FICS from your
page
-----


Index of new news items:
1465 (Mon, Dec 12) Support a research project
1469 (Sat, Mar 8) SR sought to maintain the interfaces webpage
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1479 (Mon, Jun 4) STCBunch Changes Website Address
news: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 48, 49, 50, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, 77, 78, 79, 80, 81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92, 93, 94, 95, 96, 97, 98, 99, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 124, 125, 126, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151, 152, 153, 154, 155, 156, 157, 158, 159, 160, 161, 162, 163, 164, 165, 166, 167, 168, 169, 170, 171, 172, 173, 174, 175, 176, 177, 178, 179, 180, 181, 182, 183, 184, 185, 186, 187, 188, 189, 190, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202, 203, 204, 205, 206, 207, 208, 209, 210, 211, 212, 213, 214, 215, 216, 217, 218, 219, 220, 221, 222, 223, 224, 225, 226, 227, 228, 229, 230, 231, 232, 233, 234, 235, 236, 237, 238, 239, 240, 241, 242, 243, 244, 245, 246, 247, 248, 249, 250, 251, 252, 253, 254, 255, 256, 257, 258, 259, 260, 261, 262, 263, 264, 265, 266, 267, 268, 269, 270, 271, 272, 273, 274, 275, 276, 277, 278, 279, 280, 281, 282, 283, 284, 285, 286, 287, 288, 289, 290, 291, 292, 293, 294, 295, 296, 297, 298, 299, 300, 301, 302, 303, 304, 305, 306, 307, 308, 309, 310, 311, 312, 313, 314, 315, 316, 317, 318, 319, 320, 321, 322, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 333, 334, 335, 336, 337, 338, 339, 340, 341, 342, 343, 344, 345, 346, 347, 348, 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 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1847, 1848, 1849, 1850, 1851, 1852, 1853, 1854, 1855, 1856, 1857, 1858, 1859, 1860, 1861, 1862, 1863, 1864, 1865, 1866, 1867, 1868, 1869, 1870, 1871, 1872, 1873, 1874, 1875, 1876, 1877, 1878, 1879, 1880, 1881, 1882, 1883, 1884, 1885, 1886, 1887, 1888, 1889, 1890, 1891, 1892, 1893, 1894, 1895, 1896, 1897, 1898, 1899, 1900, 1901, 1902, 1903, 1904, 1905, 1906, 1907, 1908, 1909, 1910, 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, 1919, 1920, 1921, 1922, 1923, 1924, 1925, 1926, 1927, 1928, 1929, 1930, 1931, 1932, 1933, 1934, 1935, 1936, 1937, 1938, 1939, 1940, 1941, 1942, 1943, 1944, 1945, 1946, 1947, 1948, 1949, 1950, 1951, 1952, 1953, 1954, 1955, 1956, 1957, 1958, 1959, 1960, 1961, 1962, 1963, 1964, 1965, 1966, 1967, 1968, 1969, 1970, 1971, 1972, 1973, 1974, 1975, 1976, 1977, 1978, 1979, 1980, 1981, 1982, 1983, 1984, 1985, 1986, 1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095,
```

Solution

BabaChess [connected] - [Examining NoPawnPlease vs. kropolsky [Game 27]]

File View Actions Game Edit Quick commands Window Plugins Help

NoPawnPlease vs. kropolsky [27]



kropolsky (1903)
10:09
Lag: --
8:26
Lag: --
NoPawnPlease (1982)

15 0 rated standard

21. ♖h3 [17.9]

21. e4 c5
2. ♘f3 d6
3. d4 cxd4
4. ♘xd4 ♘f6
5. ♘c3 a6
6. ♗g5 e6
7. f4 ♗e7
8. ♗f3 ♗c7
9. O-O-O ♘b4
10. ♘b1 b5
11. ♗d3 ♗b7
12. ♗he1 b4
13. ♘ce2 ♘c5
14. g4 ♘f6e4
15. ♗e3 ♘xg5
16. ♗g5 ♘xd3
17. ♗xd3 e5
18. ♘f5 O-O
19. ♘eg3 ♗f8
20. ♘h5 ♗f8
21. ♗h3 e4
22. ♗le3 ♗c8
23. ♗e1 d5
24. ♗h4 d4
25. ♘f6+ gxf6
26. ♗h3 h6
27. ♘xh6+ ♗xh6
28. ♗xh6 d3
29. ♗h8#

Console (connected)

FICS web page: <http://www.freechess.org> - add a link to FICS from your page

Index of new news items:
1465 (Mon, Dec 12) Support a research project
1469 (Sat, Mar 8) SR sought to maintain the interfaces webpage
1471 (Sun, Mar 11) 13th DESC Open Team Tournament (E-mail)
1473 (Tue, Mar 18) Relay Operators Wanted! Here's an opportunity to help out on FICS!
1474 (Sun, Apr 15) xboard 4.6.1 released
1475 (Sun, Apr 22) YaFi 0.6.25 for Android - Released.
1477 (Wed, May 16) STC Bunch May Mania Rd3 Delayed
1478 (Mon, May 28) ficsgames.com is ficsgames.org now
1479 (Mon, Jun 4) STCBunch Changes Website Address
1485 (Fri, Sep 14) FICS Lightning Championship 2012
("news <n>" will display item number 'n')

You have 8 messages (8 unread).
Use "messages u" to view unread messages and "clearmessages *" to clear all.

Present company includes: hajo.

You have 6 adjourned games.
1 player, who has an adjourned game with you, is online:
kaupermood

You are no longer examining game 27.
Game 27: NoPawnPlease goes forward 999 moves.
Game 27: Black checkmated 1-0
:wamer(T0) t-shouts: 1 0 r SS\? tourney: "td join 46" to join.

Info window

#	White rat..	White name	Black rat..	Black name	Time	Type
1	----	Najdorf	----	Nunn	0 0	unrated untimed (examine)
2	++++	GuestYWF	++++	GuestTR/N	2 12	unrated blitz
3	1113	stoms	1180	kbourne	6 0	rated blitz
4	++++	JFM	++++	GuestJHLH	10 0	unrated blitz
5	2133	bistrometh	1580	disprodit	15 15	rated standard
6	1555	nobledictat	1435	disoyuches	15 0	rated standard
7	++++	GuestWCVC	++++	GuestKMYB	30 5	unrated standard

Chat Comment Analysis Observers

You are no longer examining game 27.
--- Examining NoPawnPlease vs. kropolsky ---
NoPawnPlease goes forward 999 moves.
Black checkmated 1-0

Kbtz

For Help, press F1

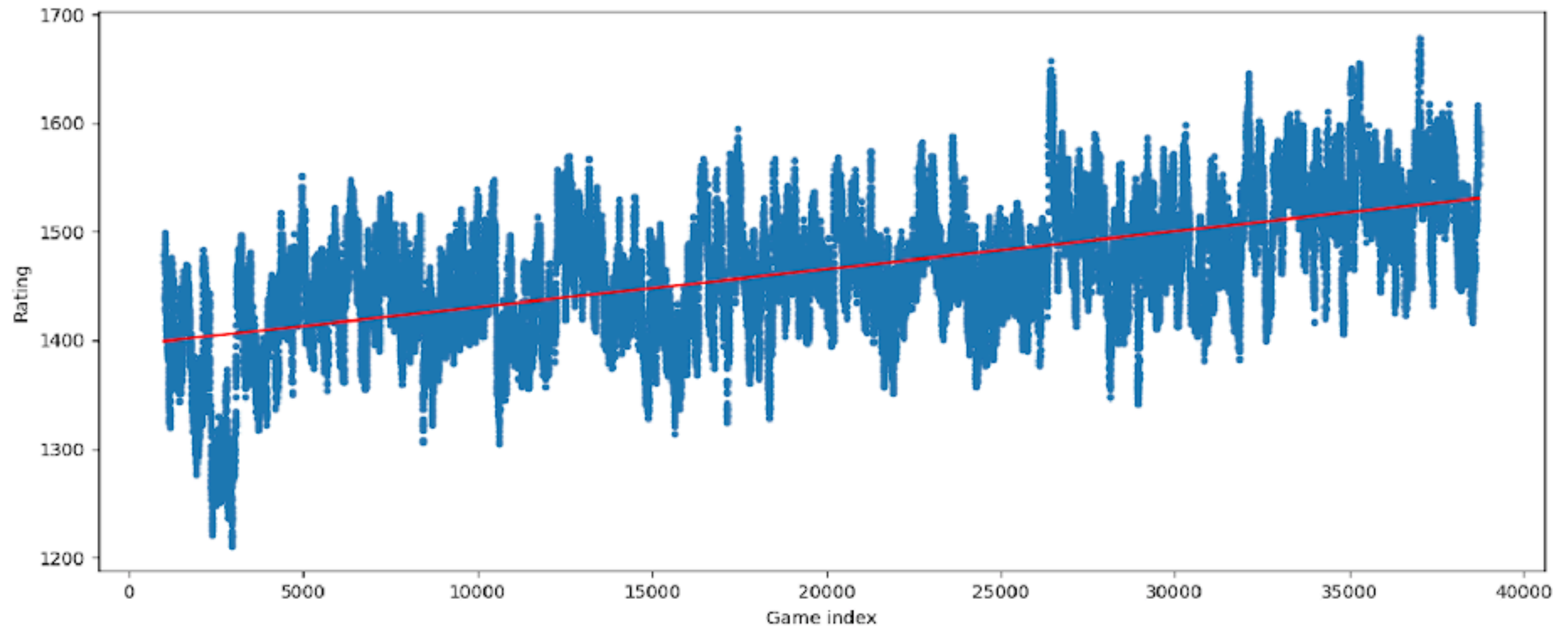
Online Chess

We study behaviour around 133 million chess games played by 70,000 players over a 15-year period

Chess ratings measure a player's ability

Examine motivation near personal best ratings

One Player



Player Profile

	rating	RD	win	loss	draw	total	best
Blitz	1464	41.3	5638	7092	747	13477	1573 (12-Nov-2016)
Standard	1723	193.8	142	116	19	277	1740 (16-Aug-2012)
Lightning	1469	77.1	17	66	4	87	1484 (07-Dec-2016)

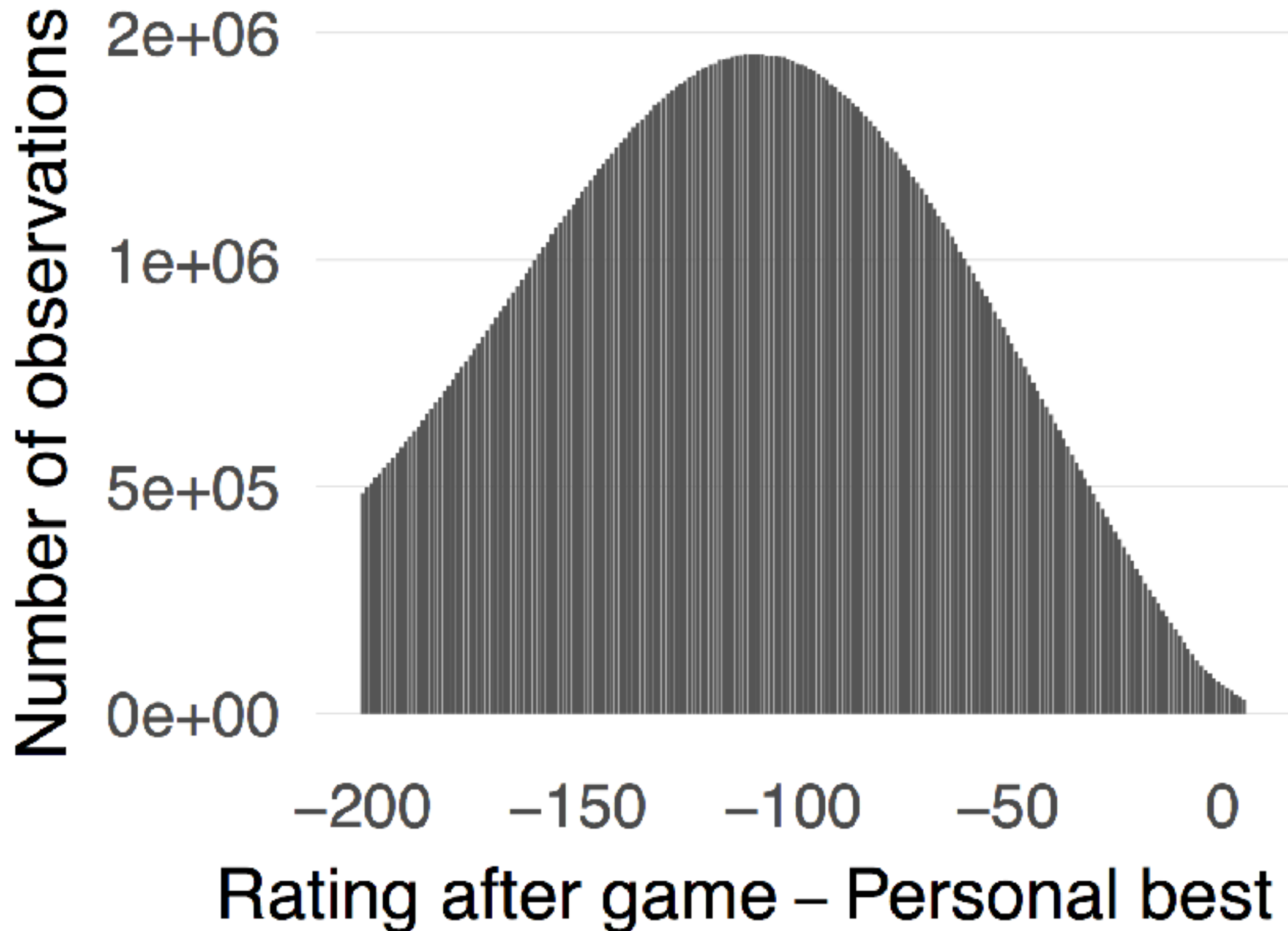
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Standard	1723	193.8	142	116	19	277	1740	(16-Aug-2012)
Lightning	1469	77.1	17	66	4	87	1484	(07-Dec-2016)

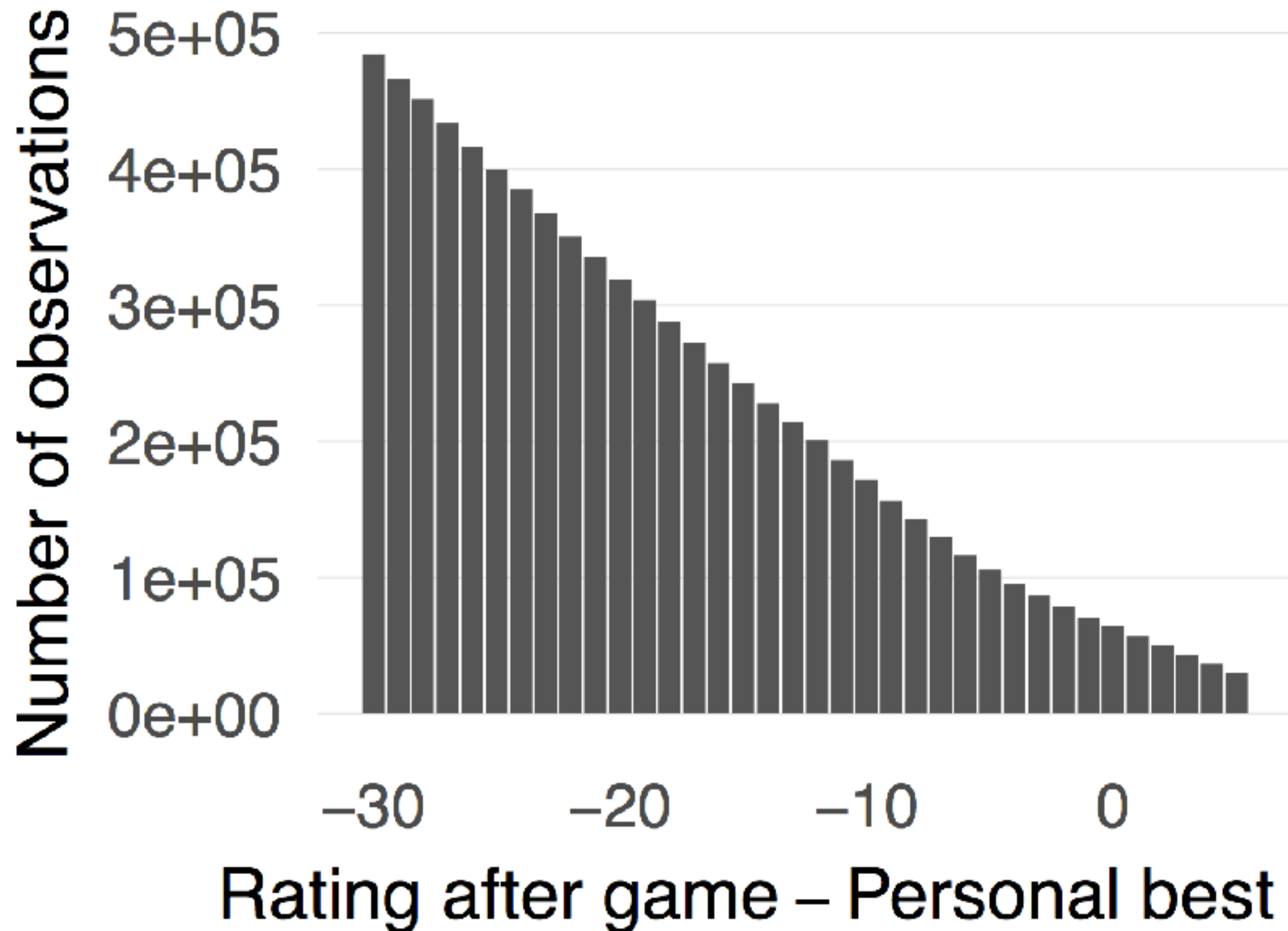
$$1464 - 1573 = -91$$

At any one time, your current rating is a certain distance away
from your personal best

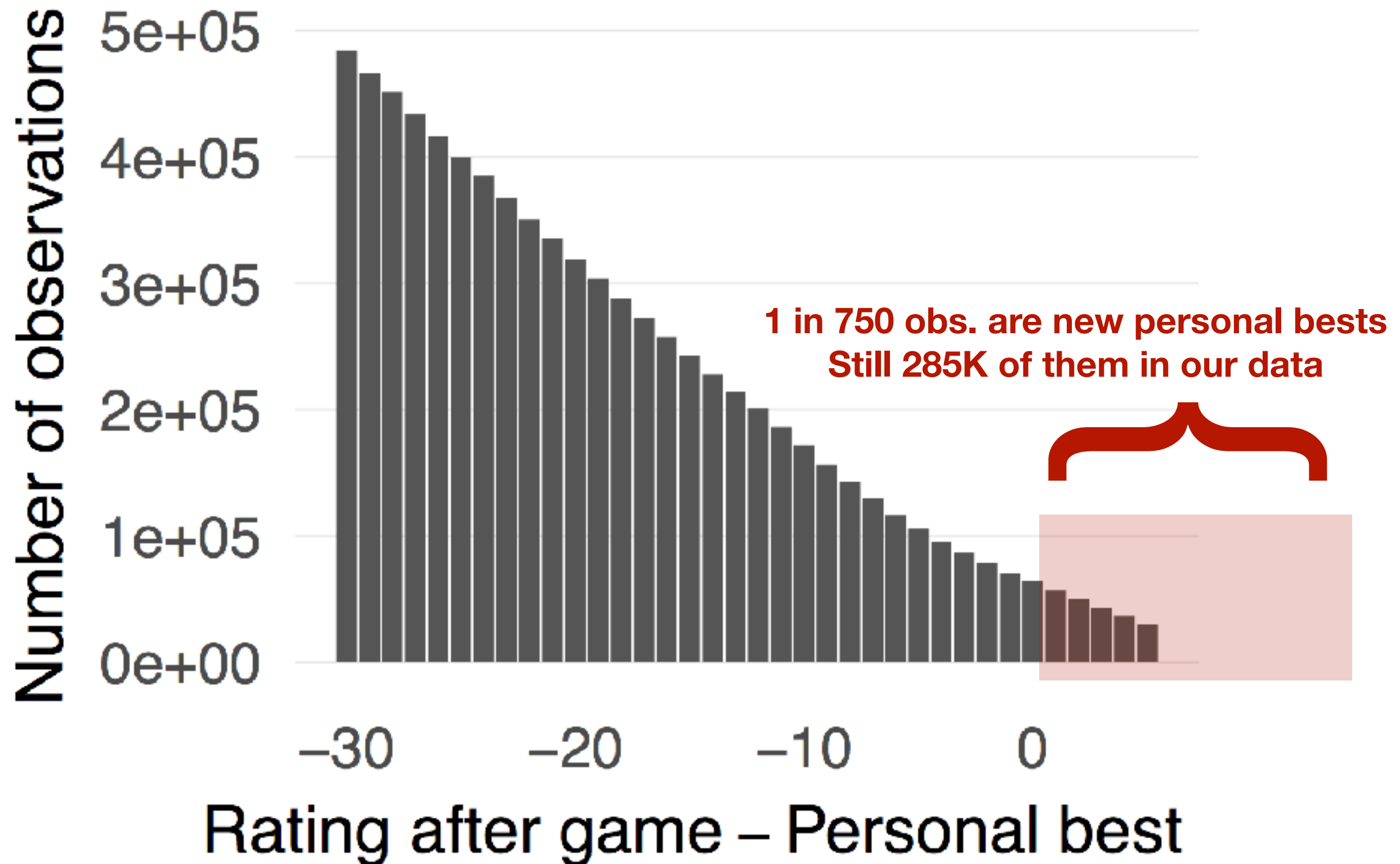
Distribution of Ratings



Distribution of Ratings



Distribution of Ratings



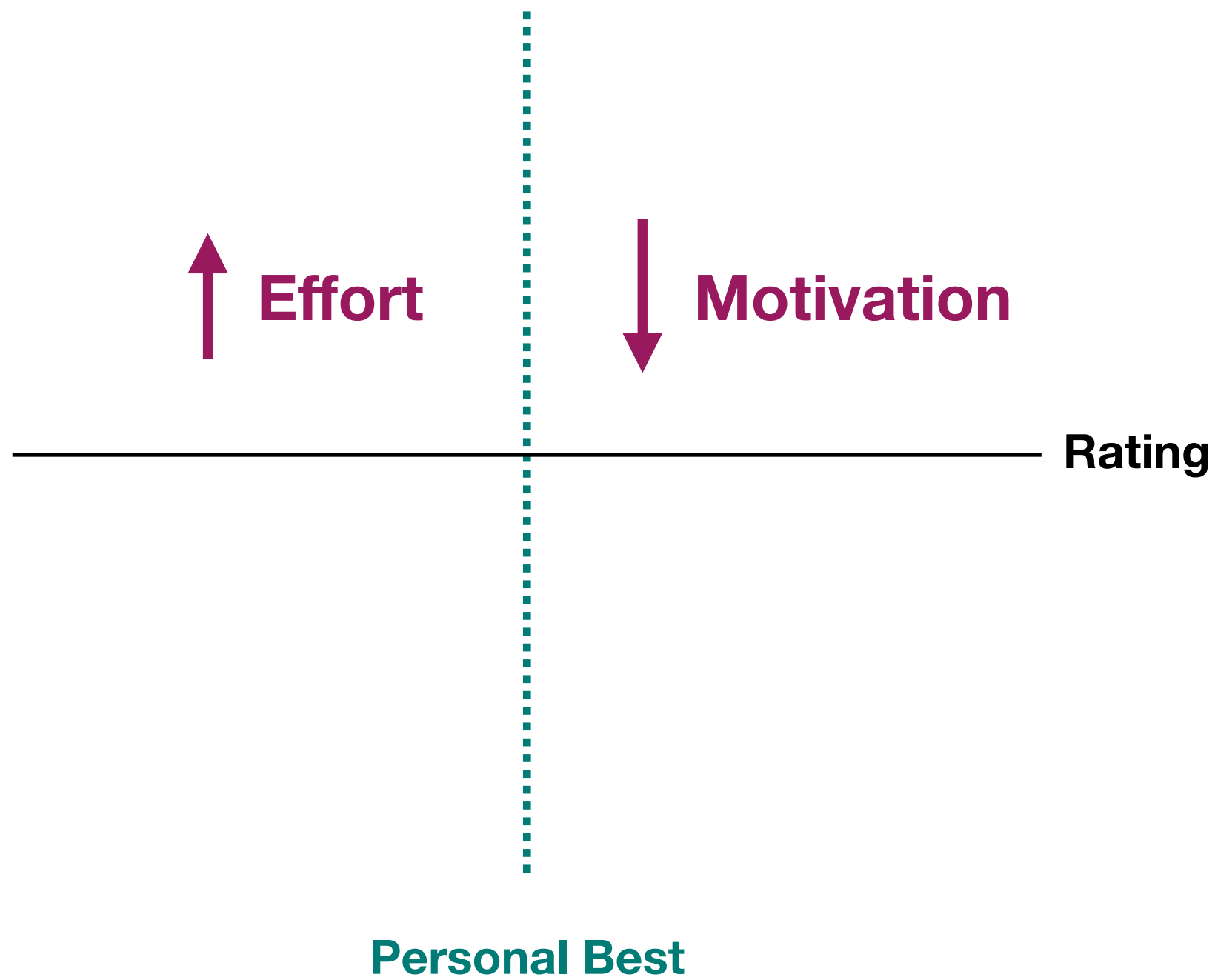
Predictions

What should we expect if players treat their personal best as a reference point?

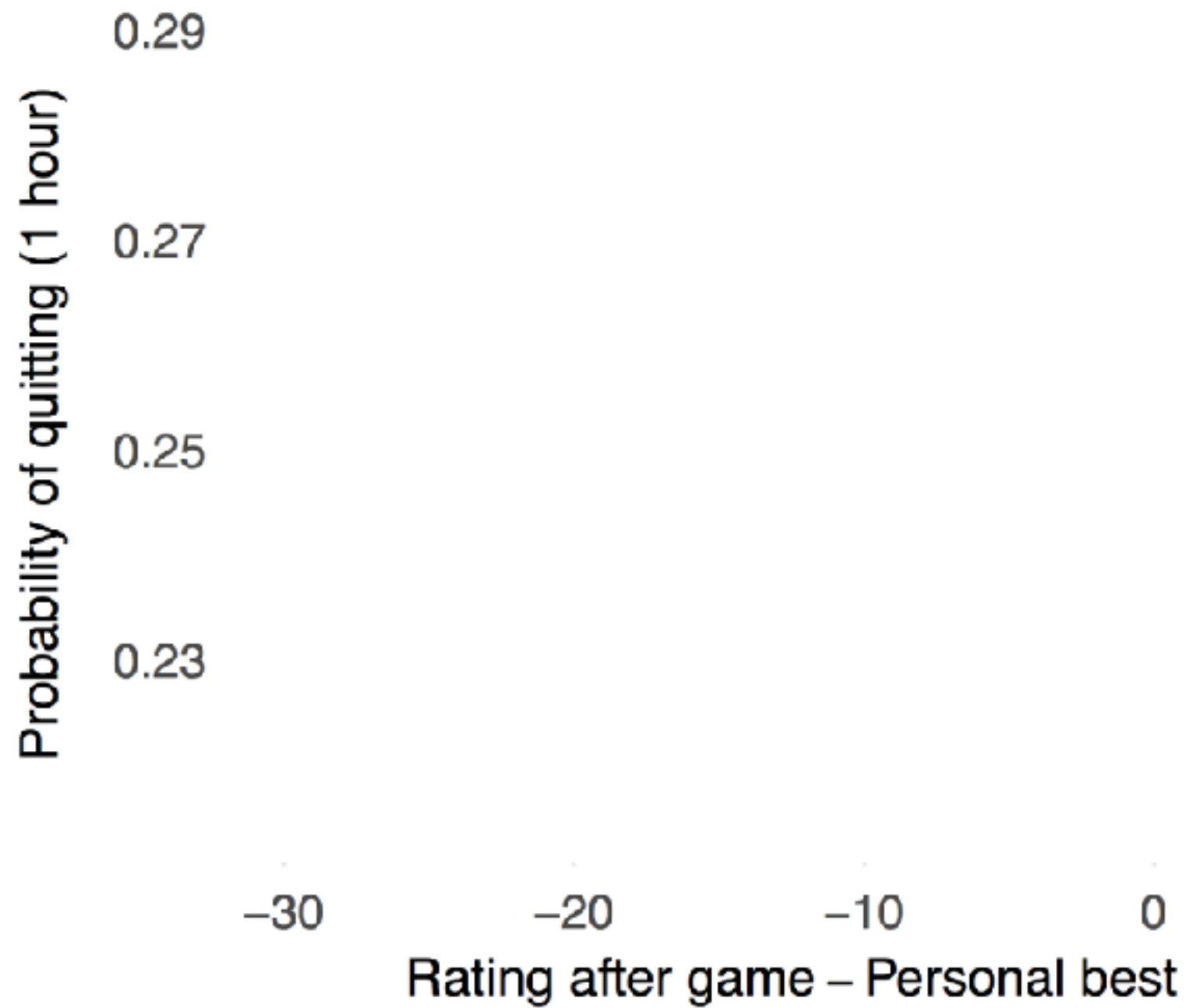
Predictions

Our simple prospect theory utility model predicts:

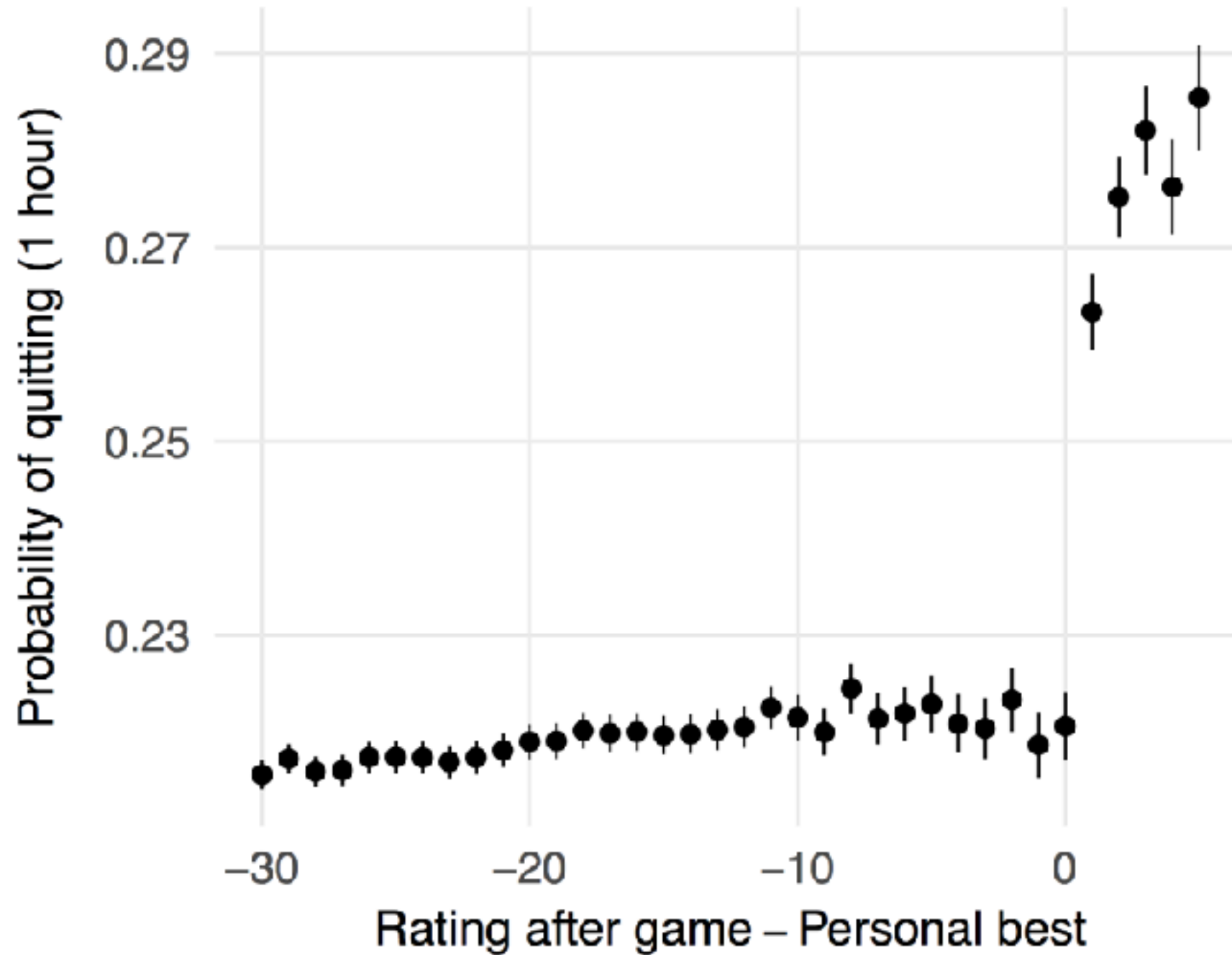
- 1. Less motivation after personal best:**
discontinuous jump in leaving after setting a personal best
- 2. More effort before personal best:** in-game effort increases as players approach a personal best



1. Quitting



1. Quitting



discontinuous jump after setting a personal best

1. Quitting

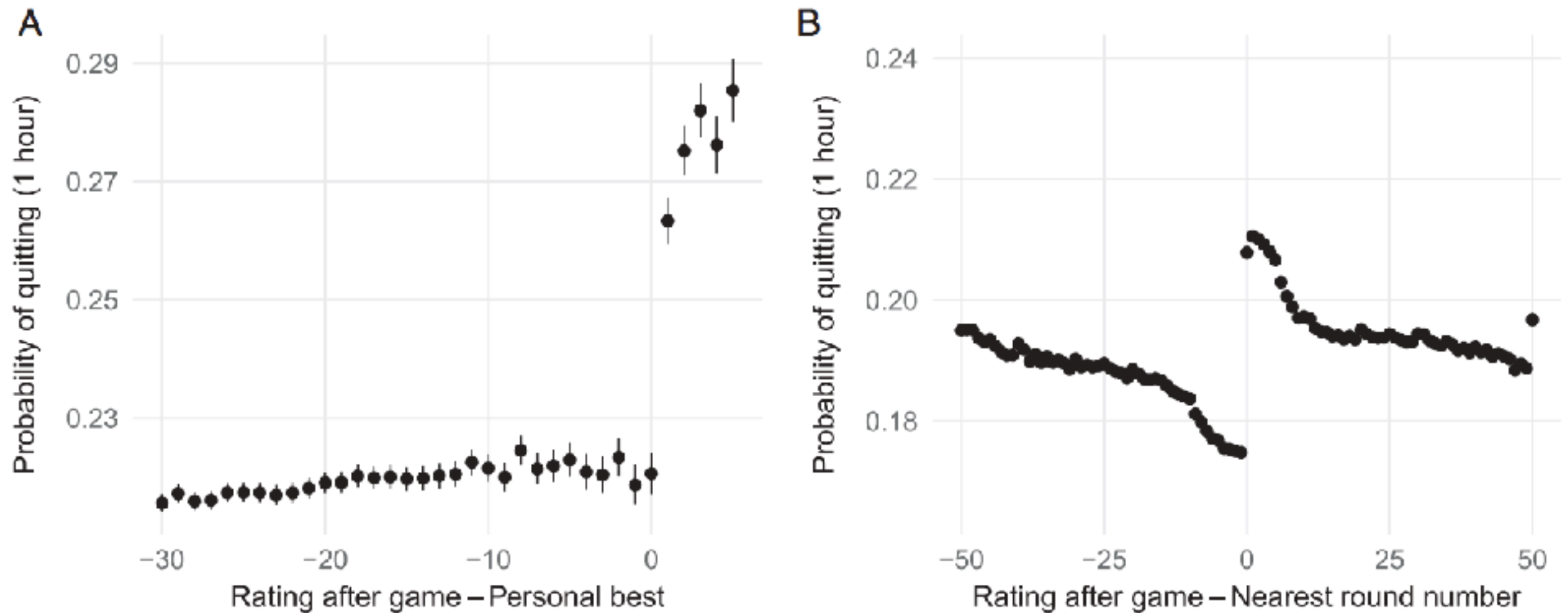
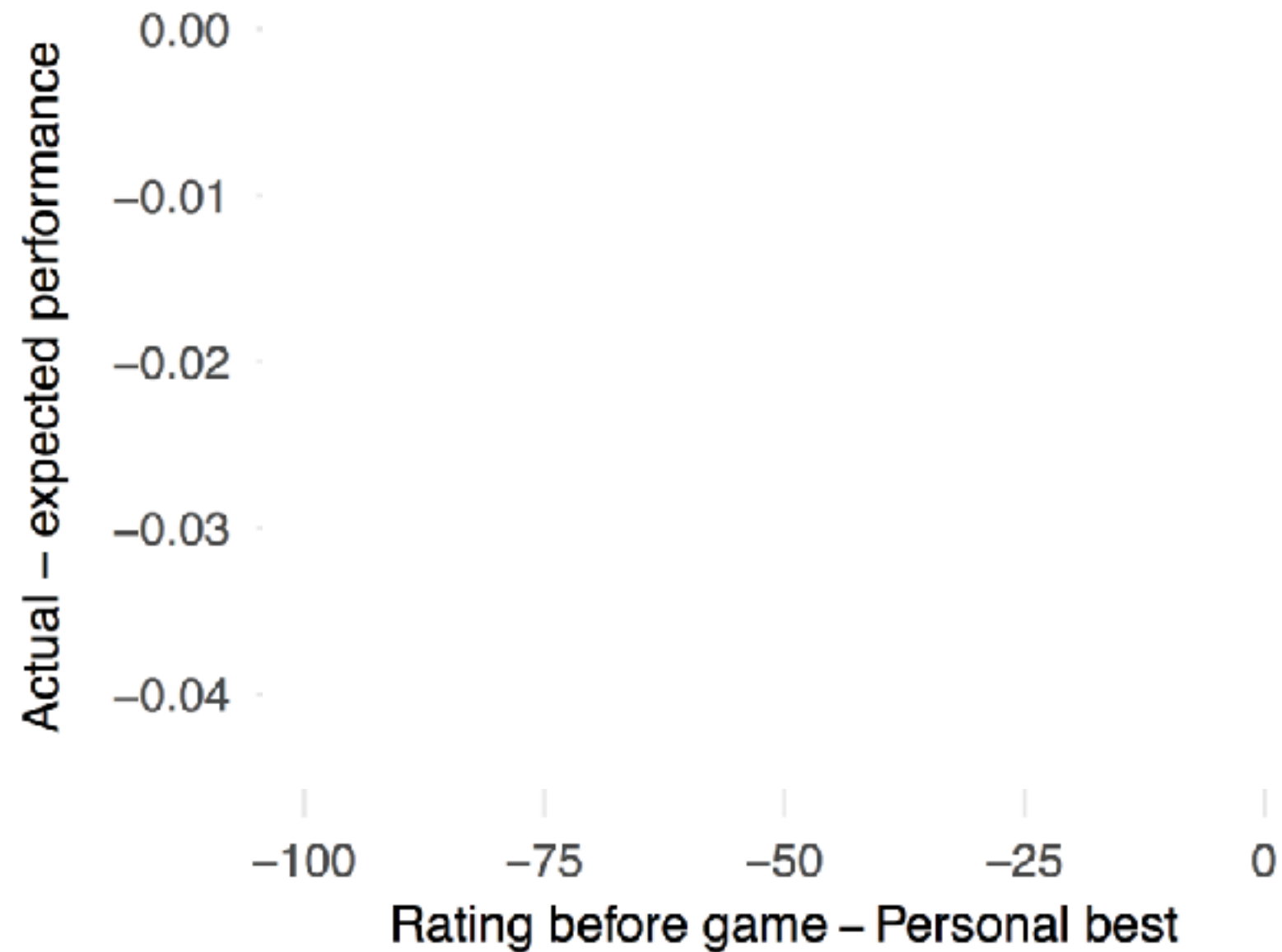


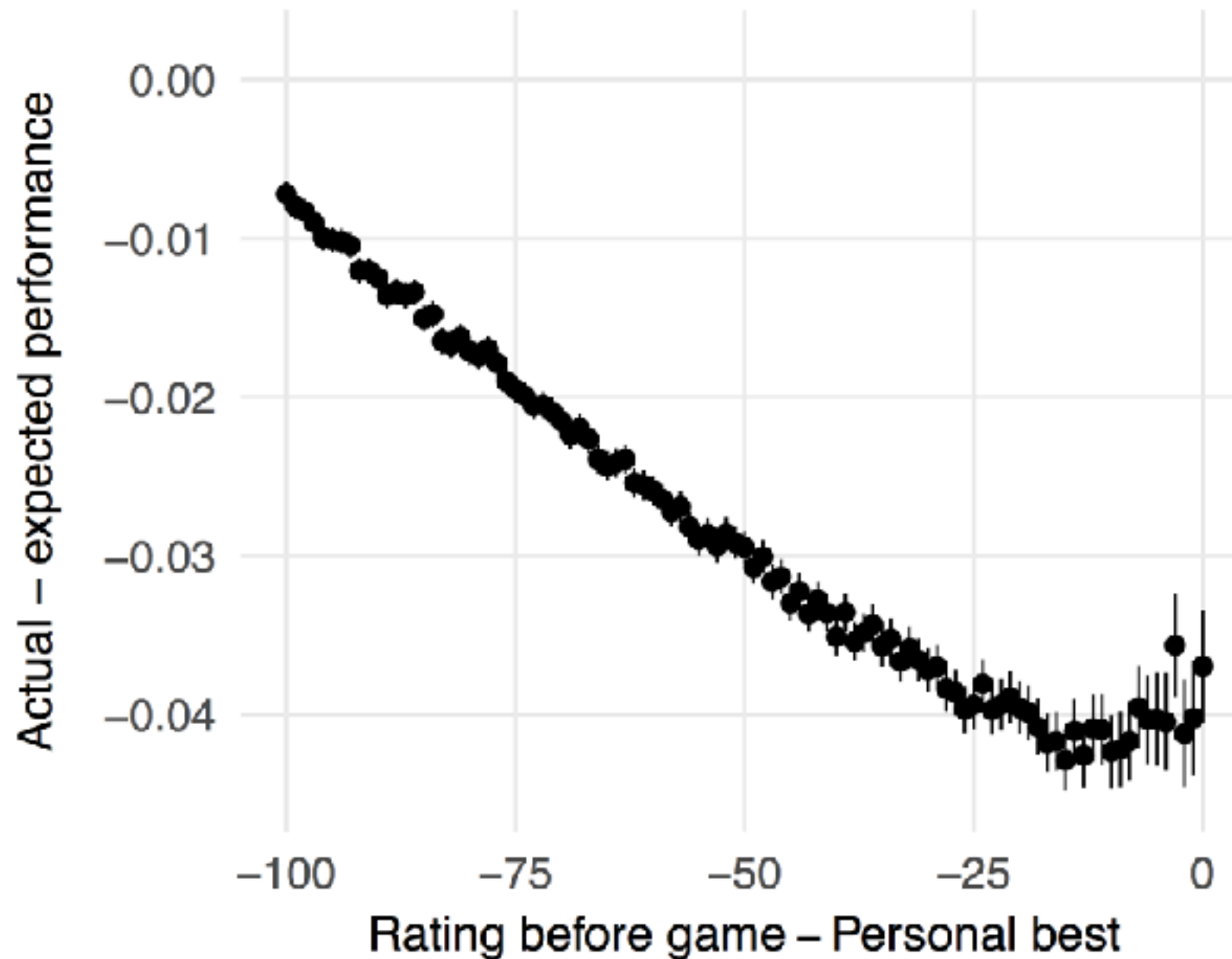
Fig. 3. Probability of quitting for at least 1 h around personal bests (A) and round numbers (B), with 95% confidence intervals.

Personal bests motivate as powerfully as round numbers

2. Effort (Performance relative to expectations)



2. Effort (Performance relative to expectations)



in-game effort increases as players approach a personal best

2. Effort (Performance relative to expectations)

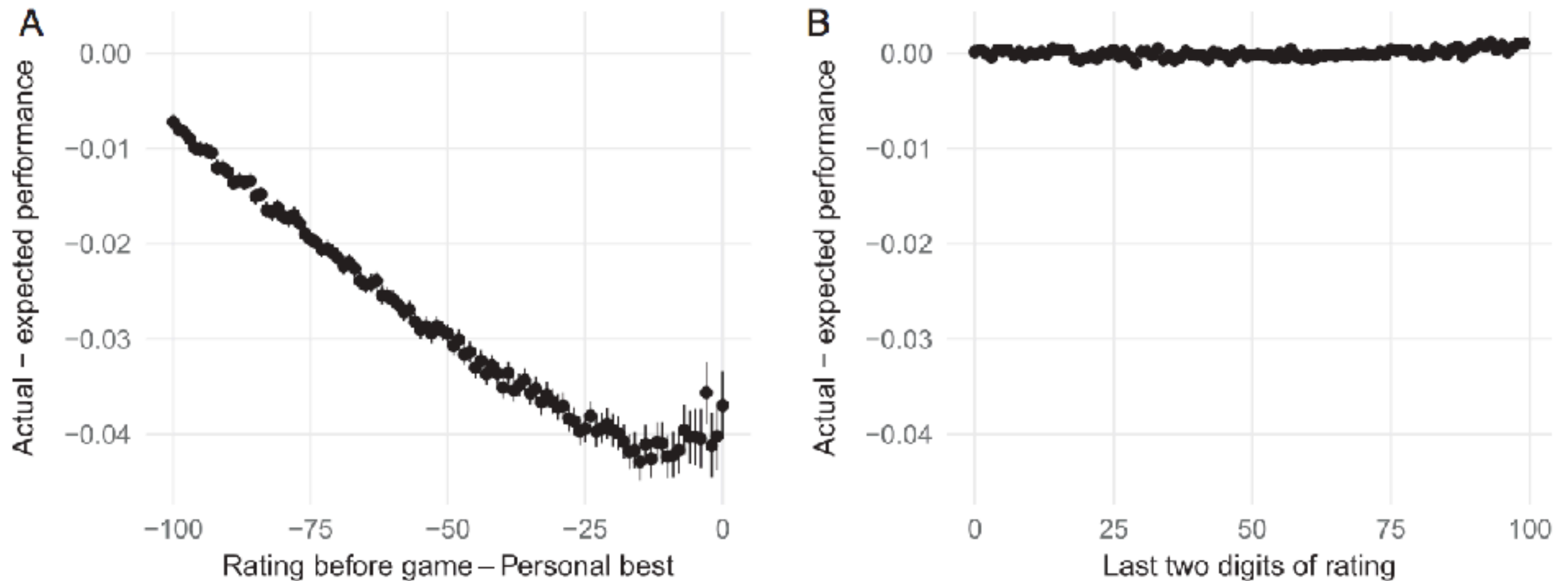


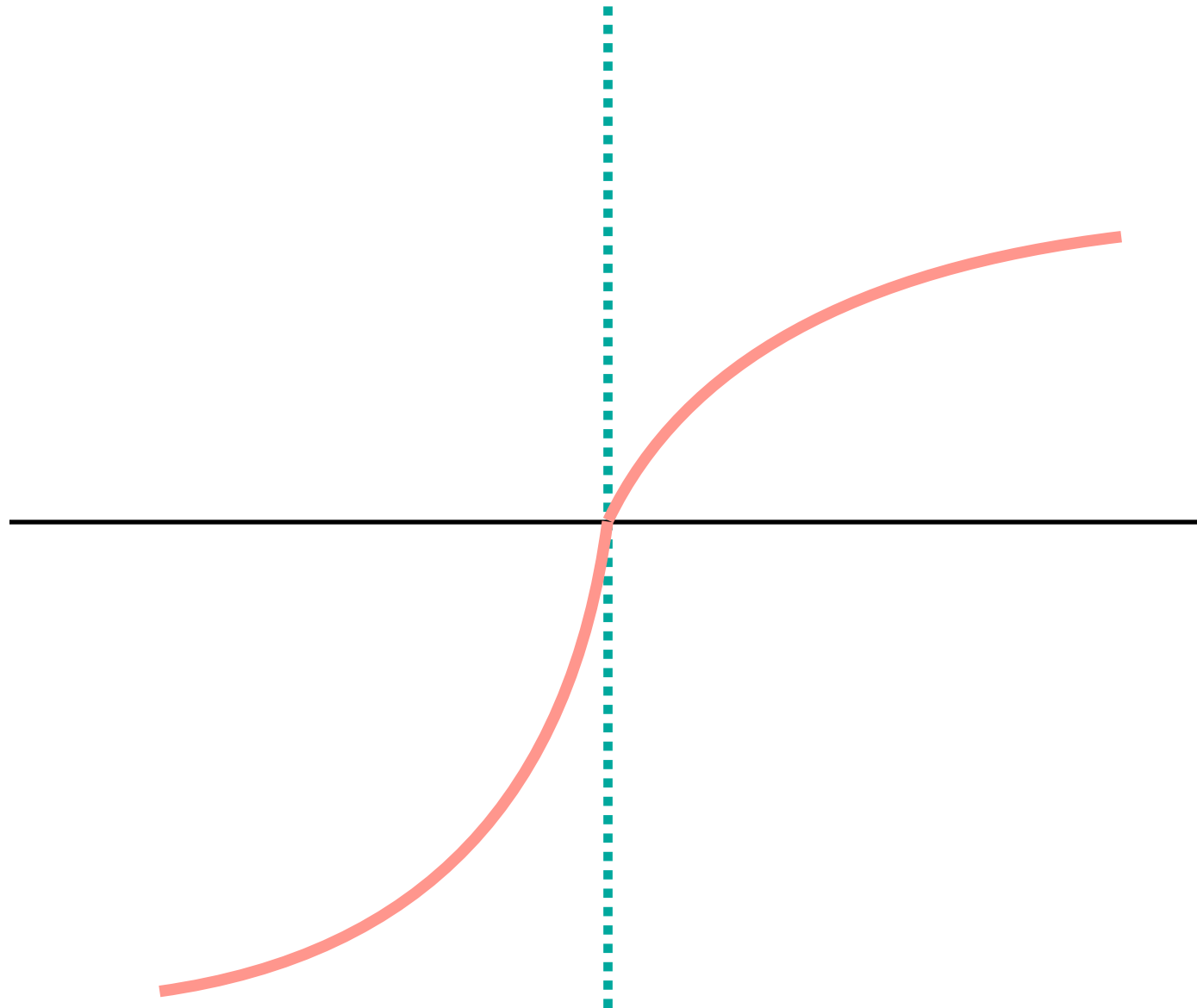
Fig. 4. Performance short of personal bests (A) and round numbers (B), with 95% confidence intervals.

Personal bests motivate much more than round numbers

Losses

Gains

Personal Best



Personal Bests

Measurement of performance is proliferating:

Step counters, calorie tracking, weight loss

Test scores, course reviews

Finances, monthly spending

**These advances may motivate people
to try to be their best selves**

Personal Bests

In seminal work [Locke & Latham], **specific** and **difficult** goals motivate more than vaguely saying “do your best”

Here we find that your **personal best** is a specific and individually calibrated goal
...and it motivates as a reference point

Thanks

People exert more effort to achieve personal bests
and quit while they're ahead

PNAS PNAS

Personal bests as reference points

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Edited by Jose A. Scheinkman, Columbia University, New York, NY, and approved January 9, 2018 (received for review April 19, 2017)

Personal bests act as reference points. Examining 133 million chess games, we find that players exert effort to set new personal best ratings and quit once they have done so. Although specific and difficult goals have been shown to inspire greater motivation than vague pronouncements to “do your best,” doing one’s best can be a specific and difficult goal—and, as we show, motivates in a manner predicted by loss aversion.

reference points | personal bests | loss aversion | motivation | goals

There is nothing noble in being superior to your fellow man; true nobility is being superior to your former self.

Attributed to Ernest Hemingway

duct comparable tests for round-numbered ratings. Whereas personal bests influence both decisions over whether to play and how much effort to exert during games, round numbers only influence decisions over whether to play.

The literature on goal setting concludes that specific and appropriately difficult goals inspire greater motivation than vague pronouncements to “do your best” (14, 15). Yet, when performance is quantifiable, doing one’s best is a specific goal. It is also calibrated to be appropriately difficult (cf. ref. 16)—rarely impossible, and, if too easy, quickly surpassed and reset. We show that people exert effort to do their best and quit once they have done so, consistent with loss aversion around personal best reference points.

<http://www.pnas.org/content/115/8/1772>

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