The Hot Hand in Basketball

On the Misperception of Random Sequences

By Gilovich, Vallone, and Tversky (1985), Cognitive Psychology

SURVEY OF BASKETBALL FANS

- With Sequential dependence among shots.
- Agreement: 91%
- Free throws:
- Agreement: 68%

- Basketball fans believe in “streak shooting.”

2. PROFESSIONAL BASKETBALL FIELD GOAL DATA

Part 1. Analysis of Conditional Probabilities

- Do players hit a higher percentage of their shots after having just made their last shot (or last several shots), than after having just missed their last shot (or last several shots)?

Part 1. Analysis of Conditional Probabilities

TABLE 1

Probability of Making a Shot Conditioned on the Outcome of Previous Shots for Nine Members of the Philadelphia 76ers

Player	*P*(hit/3 misses)	*P*(hit/2 misses)	*P*(hit/1 miss)	*P*(hit)	*P*(hit/1 hit)	*P*(hit/2 hits)	*P*(hit/3 hits)	Serial correlation *r*
Clint Richardson	.50 (12)	.47 (32)	.56 (101)	.50 (248)	.49 (105)	.50 (46)	.48 (21)	−.020
Julius Erving	.52 (90)	.51 (191)	.51 (408)	.52 (884)	.53 (428)	.52 (211)	.48 (97)	.016
Lionel Hollins	.50 (40)	.49 (92)	.46 (200)	.46 (419)	.46 (171)	.46 (65)	.32 (25)	−.004
Maurice Cheeks	.77 (13)	.60 (38)	.60 (126)	.56 (339)	.55 (166)	.54 (76)	.59 (32)	−.038
Caldwell Jones	.50 (20)	.48 (48)	.47 (117)	.47 (272)	.45 (108)	.43 (37)	.27 (11)	−.016
Andrew Toney	.52 (33)	.53 (90)	.51 (216)	.46 (451)	.43 (190)	.40 (77)	.34 (29)	−.083
Bobby Jones	.61 (23)	.58 (66)	.58 (179)	.54 (433)	.53 (207)	.47 (96)	.53 (36)	−.049
Steve Mix	.70 (20)	.56 (54)	.52 (147)	.52 (351)	.51 (163)	.48 (77)	.36 (33)	−.015
Daryl Dawkins	.88 (8)	.73 (33)	.71 (136)	.62 (403)	.57 (222)	.58 (111)	.51 (55)	−.142**
Weighted means	.56	.53	.54	.52	.51	.50	.46	−.039

Note. Since the first shot of each game cannot be conditioned, the parenthetical values in columns 4 and 6 do not sum to the parenthetical value in column 5. The number of shots upon which each probability is based is given in parentheses.

* $p < .05$.

** $p < .01$.

Part 2. Analysis of Runs

- The Wald-Wolfowitz run test

TABLE 2
Runs Test—Philadelphia 76ers

Players	Hits	Misses	Number of runs	Expected number of runs	Z
Clint Richardson	124	124	128	125.0	−0.38
Julius Erving	459	425	431	442.4	0.76
Lionel Hollins	194	225	203	209.4	0.62
Maurice Cheeks	189	150	172	168.3	−0.41
Caldwell Jones	129	143	134	136.6	0.32
Andrew Toney	208	243	245	225.1	−1.88
Bobby Jones	233	200	227	216.2	−1.04
Steve Mix	181	170	176	176.3	0.04
Daryl Dawkins	250	153	220	190.8	−3.09**
M =	218.6	203.7	215.1	210.0	−0.56

* $p < .05$.
** $p < .01$.

Part 3. Analysis of Stability across Games-Hot and Cold Nights

- The Lexis ratios for these seven players
- ranged from 0.56 (Dawkins) to 1.03 (Erving), with a mean of 0.84. No
- player’s Lexis ratio was significantly greater than 1, indicating that variations
- in shooting percentages across games do not deviate from their
- overall shooting percentage enough to produce significantly more hot (or cold) nights than expected by chance.

3. PROFESSIONAL BASKETBALL FREE-THROW DATA

- **FREE-THROW**：
  A test of the dependence between successive shots
  Free from effect of shot selection and opposing defense.
- Basketball fans: positive dependency between successive free throws
- Do players actually hit a higher percentage of their second free throws after having just made their first free throw than after having just missed
  their first free throw?

3. PROFESSIONAL BASKETBALL FREE-THROW DATA

TABLE 3

Probability of Making a Second Free Throw Conditioned on the Outcome of the First Free Throw for Nine Members of the Boston Celtics during the 1980–1981 and 1981–1982 Seasons

Player	$P(H_2/M_1)$	$P(H_2/H_1)$	Serial correlation r
Larry Bird	.91 (53)	.88 (285)	−.032
Cedric Maxwell	.76 (128)	.81 (302)	.061
Robert Parish	.72 (105)	.77 (213)	.056
Nate Archibald	.82 (76)	.83 (245)	.014
Chris Ford	.77 (22)	.71 (51)	−.069
Kevin McHale	.59 (49)	.73 (128)	.130
M. L. Carr	.81 (26)	.68 (57)	−.128
Rick Robey	.61 (80)	.59 (91)	−.019
Gerald Henderson	.78 (37)	.76 (101)	−.022

Note. The number of shots upon which each probability is based is given in parentheses.

4. CONTROLLED SHOOTING EXPERIMENT

- An alternative method for eliminating the effects of shot selection and defensive pressure

Part 1. Analysis of Conditional Probabilities

TABLE 4

Probability of Making a Shot Conditioned on the Outcome of Previous Shots for All Cornell Players

Player	*P*(hit/3 misses)	*P*(hit/2 misses)	*P*(hit/1 miss)	*P*(hit)	*P*(hit/1 hit)	*P*(hit/2 hits)	*P*(hit/3 hits)	Serial correlation *r*
Males								
1	.44 (9)	.50 (18)	.61 (46)	.54 (100)	.49 (53)	.48 (25)	.50 (12)	−.118
2	.43 (28)	.33 (42)	.35 (65)	.35 (100)	.35 (34)	.25 (12)	.00 (3)	−.001
3	.67 (6)	.68 (19)	.49 (39)	.60 (100)	.67 (60)	.62 (40)	.60 (25)	.179
4	.47 (15)	.45 (29)	.43 (53)	.40 (90)	.36 (36)	.23 (13)	.33 (3)	−.073
5	.75 (12)	.60 (30)	.47 (57)	.42 (100)	.36 (42)	.40 (15)	.33 (6)	−.117
6	.25 (12)	.38 (21)	.48 (42)	.57 (100)	.65 (57)	.62 (37)	.65 (23)	.173
7	.29 (7)	.50 (16)	.47 (32)	.56 (75)	.64 (42)	.63 (27)	.65 (17)	.174
8	.50 (6)	.50 (12)	.52 (25)	.50 (50)	.46 (24)	.64 (11)	.57 (7)	−.062
9	.35 (20)	.33 (30)	.35 (46)	.54 (100)	.72 (53)	.79 (38)	.83 (30)	.370**
10	.57 (7)	.50 (14)	.64 (39)	.59 (100)	.79 (38)	.60 (35)	.57 (21)	−.058
11	.57 (7)	.61 (18)	.56 (41)	.58 (100)	.59 (58)	.62 (34)	.62 (21)	.025
12	.41 (17)	.43 (30)	.46 (56)	.44 (100)	.42 (43)	.39 (18)	.43 (7)	−.046
13	.40 (5)	.62 (13)	.67 (39)	.61 (100)	.58 (60)	.56 (34)	.50 (18)	−.084
14	.50 (6)	.62 (16)	.60 (40)	.59 (100)	.58 (59)	.59 (34)	.60 (20)	−.031
Females								
1	.67 (9)	.61 (23)	.55 (51)	.48 (100)	.42 (48)	.45 (20)	.33 (9)	−.132
2	.43 (28)	.36 (44)	.31 (65)	.34 (100)	.41 (34)	.36 (14)	.40 (5)	.104
3	.36 (25)	.38 (40)	.33 (60)	.39 (100)	.49 (39)	.42 (19)	.50 (8)	.154
4	.27 (30)	.33 (45)	.34 (68)	.33 (100)	.29 (31)	.33 (9)	.33 (3)	−.048
5	.22 (27)	.36 (42)	.34 (64)	.35 (100)	.37 (35)	.50 (12)	.20 (5)	.028
6	.54 (11)	.58 (26)	.52 (54)	.46 (100)	.38 (45)	.41 (17)	.29 (7)	−.141
7	.32 (25)	.28 (36)	.36 (58)	.41 (100)	.49 (41)	.65 (20)	.62 (13)	.126
8	.67 (9)	.55 (20)	.57 (47)	.53 (100)	.50 (52)	.58 (26)	.73 (15)	−.075
9	.46 (13)	.55 (29)	.47 (55)	.45 (100)	.41 (44)	.47 (17)	.50 (8)	−.064
10	.32 (19)	.34 (29)	.46 (54)	.47 (100)	.47 (45)	.67 (21)	.71 (14)	.004
11	.50 (10)	.56 (23)	.51 (47)	.53 (100)	.56 (52)	.50 (28)	.39 (13)	.047
12	.32 (37)	.32 (54)	.27 (74)	.25 (100)	.20 (25)	.00 (5)	— (0)	.036
M =	.45	.47	.47	.47	.48	.49	.49	.015

Note. Since the first shot cannot be conditioned, the parenthetical values in columns 4 and 6 sum to one less than the parenthetical value in column 5. The number of shots upon which each probability is based is given in parentheses.

* $p < .05$.

** $p < .01$.

Part 2. Analysis of Runs

TABLE 5
Runs Test—Cornell Players

Player	Hits	Misses	Number of runs	Expected number of runs	Z
Males					
1	54	46	56	50.7	−1.08
2	35	65	46	46.5	0.11
3	60	40	40	49.0	1.89
4	36	54	47	44.2	−0.62
5	42	58	55	49.7	−1.09
6	57	43	41	50.0	1.85
7	42	33	31	38.0	1.64
8	25	25	27	26.0	−0.29
9	54	46	32	50.7	3.78**
10	60	40	51	49.0	−0.42
11	58	42	48	49.7	0.35
12	44	56	52	50.3	−0.35
13	61	39	52	48.6	−0.72
14	59	41	50	49.4	−0.13
Females					
1	48	52	57	50.9	−1.22
2	34	66	41	45.9	1.09
3	39	61	41	48.6	1.60
4	32	68	46	44.5	−0.34
5	36	64	45	47.1	0.45
6	46	54	57	50.7	−1.28
7	41	59	43	49.4	1.33
8	53	47	54	50.8	−0.64
9	45	55	53	50.5	−0.51
10	46	54	50	50.7	0.14
11	53	47	48	50.8	0.57
12	25	75	41	38.5	−0.67
M =	45.6	51.2	46.3	47.3	.21

* $p < .05$.
** $p < .01$.

Part 3. Test of Predictability

TABLE 6
Correlations between Bets and Performance for All Cornell Players

	Shooter's bets with shooter's hits	Observer's bets with shooter's hits	Shooter's bets with previous shot	Observer's bets with previous shot	Observer's bets with shooter's bets	Observer's bets with shooter's bets, partialing out previous shot
Males						
1	.06	−.06	.44**	.76**	.25*	−.14
2	−.01	−.06	.94**	.55**	.52**	−.03
3	−.07	.01	.35**	.38**	.37**	.27**
4	−.16	−.20*	.20	.75**	.24*	.14
5	−.03	.01	.38**	−.13	−.12	−.08
6	.22*	.24*	.36**	.72**	.27**	.02
7	.18	.24*	.17	.66**	−.03	−.19
8	.04	.21	.33**	.13	.21	.18
9	.05	.21*	.47**	.55**	.12	−.19
10	.00	−.19	.31**	.09	.27**	.26*
11	−.51*	.03	.15	.12	.07	.05
12	.20*	.00	.37**	.36**	.31**	.20*
13	.00	−.11	.23*	.42**	.19	.11
14	.20*	−.05	.21*	.59**	.27**	.19
Females						
1	−.04	−.09	.52**	.37**	.24*	.06
2	.17	.05	.39**	.72**	.40**	.19
3	.05	.16	.40**	.72**	.24*	−.08
4	−.05	−.03	.49**	.12	.18	.14
5	.03	.14	.43**	.42**	.43**	.30**
6	.03	.05	.31**	.53**	.02	−.18
7	.22*	.20*	.65**	.71**	.53**	.13
8	.07	.13	.50**	−.05	.55**	.45**
9	.11	−.01	.49**	.39**	.23*	.05
10	−.01	.11	.62**	.63**	.10	−.48**
11	.11	.18	.33**	.18	.22*	.17
12	.02	−.07	.35**	.42**	−.03	−.21*
M =	.02	.04	.40	.42	.22	.05

* $p < .05$
** $p < .01$

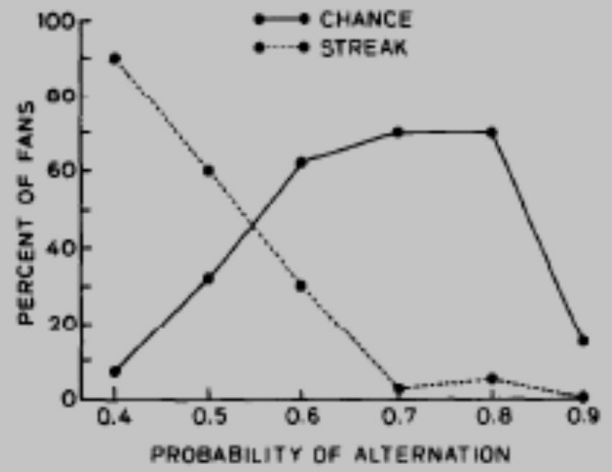

FIG. 1. Percentage of basketball fans classifying sequences of hits and misses as examples of streak shooting or chance shooting, as a function of the probability of alternation within the sequences.