Bouncing back in the World Series

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Sequences of wins and losses for each of the 86 World Series played since 1903 were analyzed for dependence between successive games. It was found that the probability of a win following a loss was significantly greater than the probability of a win following a win. It was also found that the average number of runs of wins and losses per series was greater than would be expected if games were independent. Results supported a "bounce back" phenomenon, a tendency contrary to the notion that momentum is a major factor in such competition.

It is common for sports fans and "experts" to assess performance in athletic events in terms of their perceptions of regularities that occur over the course of performance. Gilovich, Vallone, and Tversky (1985) found a belief in the notion of the "hot hand" in field-goal and free-throw shooting in basketball by both performers and observers. This belief was common despite the fact that examination of sequences of hits and misses showed no departure from randomness. This perception may reflect the application of the representativeness heuristic (Kahneman & Tversky, 1972), which would require observations in a random sequence to exhibit local, as well as overall, randomness. Cohen and Hansel (1955) found that children in their early teens tended to reject the randomness of randomly generated sequences in favor of pseudorandom sequences that did not display long sequences of a given type (e.g., "tails"), which can be expected to occur in a random sequence. In the realm of team competition, the occurrences of such sequences in the form of winning streaks are often attributed to momentum. Sportscasters often interpret repeated success over time, both within and between contests, in terms of momentum.

Is there evidence for momentum in competition in certain realms? Conversely, does this momentum shift more rapidly than would be expected if contests are independent of each other? In this case, prior research might suggest that contests would appear to be independent because of the paucity of long sequences of wins. Analyses presented here involved the sequences of wins and losses in World Series play since the inception of this playoff. Data were examined for departures from independence of successive games.

Data and Analysis

Data, compiled from Carter (1989), consisted of sequences of wins and losses for each of the 86 World Series, starting in 1903 and ending with the 1989 World Series. (The National League refused to play in 1904). The series played were best-four-of-seven series, except

for the 1903, 1919, 1920, and 1921 contests, which were best-five-of-nine series. Data from the 1919 series were included despite its suspicious nature. However, the win-loss sequence was not notably atypical and did not affect interpretation of overall results. Of the 82 best-of-seven series, 14 went four games, 20 went five games, 17 went six games, and 31 went seven games. Three of the best-of-nine series went eight games, with the remaining such series going seven games. Thus, there were 506 games available for analysis.

Data were subjected to an analysis for contingencies between successive games within series. Probability of win or loss in Game $i + 1$ following win or loss in Game i was computed for the eventual winner for $i = 1$ through 5. (Save for the four atypical series, Game 7 outcome was determined by the "stopping rule" that selects the winner.) The same computations for the eventual loser would, of course, mirror those for the eventual winner, with differences between conditional probabilities the same in both cases.

The number of runs of wins and losses prior to the final game, whose outcome is determined by the series stopping rule, was computed for each of the best-of-seven series for comparison with the number expected for random sequences. Since series of a given length involve the same numbers of wins and losses, expected number of runs and the variance are the same for all series of the same length. Thus, the average number of runs for each series length was computed, and the weighted average of these means was compared with that expected for random sequences. Finally, the number of four-game sweeps was compared with the number expected under the assumption that games are independent of each other.

Results and Discussion

Table 1 shows the probability of wins following wins and wins following losses for Games 1-5. The probability of a win following a loss was greater than that for a win following a win for all two-game sequences (except for Games 3 and 4): Overall, $p(\text{win in Game } i + 1 | \text{win in Game } i) = .62$, as compared with $p(\text{win in Game } i + 1 | \text{loss in Game } i) = .78$. The difference was highly significant [$\chi^2(1) = 9.37, p < .005$].

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Table 1
Probability of a Win Following a Loss Versus Probability of a Win Following a Win for Games Following Games 1-5

Preceding Game	Following Game	$p(W_F W_P)$	$p(W_F L_P)$
1	2	.59	.71
2	3	.53	.90
3	4	.75	.66
4	5	.67	.79
5	6	.56	.86
Total		.62	.78

Note—P = preceding game; F = following game; W = win; L = lose.

Table 2
Observed Versus Expected Average Number of Runs of Wins and Losses for Series of Lengths Five Through Seven Games

Number of Games	N	$\bar{x}(R)$	$E(R)$	$\sigma(\bar{x})$
5	20	2.70	2.50	.11 2
6	17	3.29	3.40	.22 2
7	31	4.45	4.00	.12 9
Overall	68	3.65	3.41	

Note— $\bar{x}(R)$ = observed mean runs; $E(R)$ = expected runs; $\sigma(\bar{x})$ = standard deviation of $\bar{x}(R)$.

Table 2 shows the expected number of runs for best-of-seven series of lengths 5, 6, and 7 games, together with the observed average number of runs. Only the average for six-game series was smaller than expected for random sequences. However, the average for all 82 series was significantly greater than that expected [$z = 2.70$, $p < .01$, $E(R) = 3.41$, and $\bar{x}(R) = 3.65$, in which $E(R)$ signifies the number of runs expected and $\bar{x}(R)$ represents the mean number of runs observed]. Thus, there were more runs of wins and losses than would be expected if games were independent of each other. This result is clearly consistent with the preceding analysis of conditional probabilities of outcomes for successive games.

The number of four-game sweeps was compared with the number expected if game outcomes were independent of each other with win probability for the winner equal to .50. The latter assumption probably provides a some-

what conservative expectation for the number of four-game series. However, there is no good a priori basis for deriving the expected probability. Despite some noteworthy series mismatches (e.g., the 1927 Yankee-Pirate series), there were some series swept by the underdog (e.g., the 1914 Braves-Athletics series). Thus, the equal-probability assumption may be reasonable. Under the assumption that number of games in a best-of-seven series follows Pascal's distribution with $p = .50$, conditioned upon a seven-game limit, 10.25 four-game series would be expected. The observed number of sweeps for best-of-seven series was 14, which was not significantly greater than the number expected, [$\chi^2(1) = 1.18$, $p > .75$]. Thus, despite the conservative expected value, the result does not support a notion favoring a "momentum" phenomenon.

These analyses present strong evidence that there is a negative dependence between successive games, which would result in high frequencies of relatively short winning (or losing) streaks. Such short series would tend to lead to a perception of local randomness despite the dependency that exists. Curiously, evidence supports a process that is the converse of momentum. Teams are more likely to win following a defeat than they are following a victory. Underlying processes can only be surmised. Teams are selected for the World Series by a tough season's competition. They may be characterized by resilience. Perhaps even strong teams let down in subtle ways after a victory. A combination of factors probably produces the effect. It is possible that the dependencies observed only occur at the highest levels of competition. These issues await further study.

REFERENCES

- CARTER, E. (Ed.) (1989). *The series: An illustrated history of baseball's postseason showcase*. St. Louis: Sporting News Publishing Co.
- COHEN, J., & HANSEL, C. E. M. (1955). The idea of independence. *British Journal of Psychology*, 46, 178-190.
- GILOVICH, T., VALLONE, R., & TVERSKY, A. (1985). The hot hand in basketball: On the misperception of random sequences. *Cognitive Psychology*, 17, 295-314.
- KAHNEMAN, D., & TVERSKY, A. (1972). Subjective probability: A judgment of representativeness. *Cognitive Psychology*, 3, 430-454.

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