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> If it's a steroid,
> it's not working.
> — Barry Bonds

A professional athlete's level of performance typically increases over his or her career, up to a point. Scully [1, p. 47] observed that the batting average for the sample of 96 major leaguers he examined in 1986 reached a peak between the ballplayer's sixth and seventh year of playing experience. The gains from experience ultimately decline, largely because the physical condition and the reflexes of players diminish with age. The conventional wisdom thus is that athletes in general (and baseball's sluggers in particular) lose power as they get older.

In this brief note, we examine the top four all-time career home run leaders in Major League Baseball — Henry Aaron (755), Babe Ruth (714), Barry Bonds (703, at the end of the 2004 season), and Willie Mays (660) — before and after their 35th birthday. By the time all four players reached 35 years of age, they had each played a minimum of thirteen full seasons in the major leagues [Aaron (15 seasons; retired at age 42), Ruth (16; retired at age 40), Bonds (13; 40 years old on July 24, 2004), and Mays (14; retired at age 42)]. No matter how talented the ballplayer, one would expect to see a decline (if any change) in performance in their mid-30s.

Table 1 reports season averages in selected batting categories, before and after 35 years of age, for each of the four players. The categories include: (i) home runs; (ii) home run percentage (the number of home runs per 100 times at bat) [*HR %*]; (iii) runs scored; (iv) runs batted in; (v) total bases; (vi) slugging average (total bases divided by at bats times 100); and (vii) on-base percentage plus slugging average [*OPS*]. All career statistics for Aaron, Ruth, and Mays are from the *Baseball Encyclopedia* [2]; Bonds's statistics are from the *2005 Baseball Register*

[3]. Season averages before and after the ballplayer's 35th birthday were compared using a two-sample *t*-test. Loosely speaking, the *p*-value on the difference between means is the likelihood that the null hypothesis H$_0$: $\boldsymbol{m}_{Before35}$ = $\boldsymbol{m}_{After35}$ is true against the two-tailed alternative hypothesis that the two averages are not equal. Numbers in boldface type (italics) are significant at better than the .05 level and indicate an improvement (decline) in performance after 35 years of age.

Hank Aaron's average runs scored and total bases dropped after age 35. Willie Mays's averages were all significantly lower.[1] Babe Ruth's averages did not significantly change one way or the other. But, Barry Bonds's averages were uniformly higher and significantly higher for home runs, home run percentage, slugging average, and OPS.

Concluding Remarks

When several ballplayers arrived at spring training in 2004 and less muscular than in past years, they attributed their new look to better training and more healthful eating habits. Some fans suspected that they had once been on steroids and now were not, without proof either way. At the center of the controversy is Barry Bonds who continues to chase the home run records of Babe Ruth and Hank Aaron after having passed (in 2004) his godfather, Willie Mays. Curiously, Barry Bonds is the only one of the four sluggers examined here whose home run season totals (home run percentage, slugging average, and OPS) actually *increased* after turning 35 years of age. The before-and-after comparisons presented here suggest that Bonds is either an ageless wonder or a player whose numbers should be viewed with skepticism.

Table 1. Averages in Selected Batting Categories, Before and After Age 35[a]

	Hank Aaron			Babe Ruth			Barry Bonds			Willie Mays		
	Under 35	35 or older	*p*-value on difference	Under 35	35 or older	*p*-value on difference	Under 35	35 or older	*p*-value on difference	Under 35	35 or older	*p*-value on difference
Batting Category												
Home Runs	34.0	30.6	.57	32.2	33.0	.93	31.6	48.7	**.023**	36.1	19.4	*.0042*
Home Run Percentage	5.69	6.85	.28	7.07	8.14	.32	6.27	11.69	**.0004**	6.43	4.42	*.007*
Runs Scored	106.9	71.4	*.013*	97.9	101.2	.90	104.9	117.7	.12	106.9	70.6	*.012*
Runs Batted In	108.5	83.7	.056	97.4	108.7	.69	93.5	104.5	.34	100.1	62.6	*.0094*
Total Bases	332.1	234.2	*.014*	265.0	258.0	.92	283.0	312.8	.33	321.9	194.9	*.0029*
Slugging Average	.558	.528	.50	.644	.607	.55	.557	.755	**.0014**	.582	.459	*.0009*
OPS	.932	.901	.59	1.078	1.060	.84	.965	1.262	**.0057**	.967	.827	*.0038*

[a] Age as of October 1 (or the end of the season).

References

1. G.W. Scully, *The Business of Major League Baseball*, The University of Chicago Press, Chicago, 1989.

2. *The Baseball Encyclopedia* (8th edition), Macmillan Publishing Company, New York, 1990.

3. *2005 Baseball Register*, The Sporting News, St. Louis, 2005.

Footnote

1.   When Aaron's and Mays's averages before 35 years of age are compared to those from

age 35 to (but *not* after) age 40, the results are the same for both players with one

exception. Like Bonds, Aaron's *HR %* significantly improved after age 35 ($p = .011$).