Racer Swimsuits Fit to a *T*

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"The athlete makes the suit.
It's not the suit that makes the athlete."
— Paula Schneider,
The Warnaco Group, Inc. [1]

During the 2009 swim season, some collegiate swimmers were observed wearing the same high-tech racer suits that aided Olympian swimmers the year before in Beijing. The polyurethane membrane panels on Speedo's LZR (pronounced "laser") Racer repelled water, reducing drag. These suits compressed a swimmer's body and thus enabled swimmers to displace far less water, reducing drag even more. Finally, LZR Racers, Blueseventy Nero Comps and other tech suits were designed to improve a swimmer's buoyancy. Since these body-length swimsuits lost some of their drag-diminishing properties after repeated use, elite swimmers saved them for championship meets.

Collegiate swimmers were allowed to wear the swimsuits in 2009. In July of that year, Fédération Internationale de Natation (FINA), the organization governing international competition in aquatic sports, banned all body-length high-tech swimsuits. About a month later, the National Collegiate Athletic Association (NCAA) followed FINA's ruling and also banned all "speed suits."

The introduction of the high-tech suits created a competitive imbalance at all levels of college and university swimming, including Division III. But, there were other problems for collegiate swimmers. First, not all swimmers were willing (or able) to pay for the expensive suits. The LZR Racer, for example, was about $300 to $400 for men and $400 to $550 for women. Second, there was so much demand for the suits that specific sizes sold out before some collegians decided to make their purchase. (Women's sizes allegedly ran out earlier than men's sizes.) Third, some varsity swimmers were able to get college funding for the suits, while others were not.

The purpose of this brief note is to examine the impact of the high-tech suits on swimmers in the New England Small College Athletic Conference (hereafter NESCAC) championships.[1] Did these high-tech swimsuits significantly lower racing times for both men and women? Were racing times significantly lower for both sprints and endurance events? And, how did racing times in 2010 (the first year of the ban) compare to those times in 2008 (one year before the introduction of the high-tech swimsuits to collegiate swimming)?

The Data

The variable of interest in this paper is the swimmer's "drop time," that is, the difference between a swimmer's best in-season time (called their "seed time") prior to the championship meet and their best time in the preliminaries or finals at the championships. The difference between seed times and championship times is usually positive, as swimmers taper (that is, swimmers gradually shorten the distance they swim before championships) and shave their bodies (to reduce drag) the day before the championship meet. The drop times were calculated for all swimmers, men and women, who competed and finished among the top 26 in the preliminaries of their event in either (i) the 2008 and 2009 NESCAC championships or (ii) the 2009 and 2010 NESCAC championships [2, 3].[2] It is important to note that these data are paired. For example, we only considered the drop times of individual swimmers in 2009 (when they were allowed to wear the high-tech swimsuits) and the drop times of the *same* swimmers in the same event one year before or after 2009.[3] The drop times were calculated for men and women in four freestyle events: 50 yards, 100 yards, 200 yards, and 500 yards.

The first null hypothesis is that the average drop time in 2008 (or 2010) was no different from the average drop time in 2009, the year LZR-clad swimmers were allowed to compete. The one-tailed alternative hypothesis is that the average drop time was greater in the year 2009 than it was in 2008 (or 2010). The second null hypothesis is that the average drop time differences for men and women separately were the same between (i) 2009 and 2008 and (ii) 2009 and 2010. To test this second hypothesis, we ran a 2-sample *t*-test on the average drop time differences for men and women between years at each distance (50, 100, 200, or 500 yards). In this case, the alternative hypothesis is two-tailed.

The Results

Table 1 summarizes the results for both men and women at the four distances: (i) between 2008 and 2009 and (ii) between 2009 and 2010. Drop times for men were greater in 2009 than they were in either 2008 or 2010. Moreover, the differences were statistically significant (at better than the .05 level) in four of the eight paired comparisons. In the men's 50 yard freestyle, for example, average drop times increased by .34 seconds from 2008 to 2009 (p = . 011) and then decreased by .289 seconds from 2009 to 2010 (p = .004) after the high-tech suits were banned. In other words, for the eighteen men in our sample competing in the 50 yard freestyle both years, the 2008 average drop time of .461 seconds represented a 2.08 percent improvement over their average 2008 in-season seed time. Their average drop time of .801 seconds in 2009 (the high-tech swimsuit year) represented a 3.61 percent improvement over their average 2009 in-season seed time. For the fourteen men who swam the 200 yard freestyle in 2009 and again in 2010, the 3.929 second average drop time in 2009 represented a 3.66 percent improvement over their average in-season seed time. But, for these same fourteen men in the 200 yard freestyle a year later, the 2.764 second average drop time represented only a 2.57 percent improvement over their average in-season seed time.

The drop times for women increased from 2008 to 2009 in three of the four events, but none of these changes were statistically significant. Curiously, the average drop times for women *increased* from 2009 to 2010 in all four events, while the average drop times for their male counterparts in the same four events actually decreased. In other words, male swimmers seemingly benefited more in 2009 from the high-tech swimwear than did women swimmers. And, while both men and women swam faster in the 2010 NESCAC championships than they had in-season, the women's (men's) average drop times were larger (smaller) than they were the year before.

If the high-tech swimsuits enabled competitors to swim faster, then one should find that average drop times in 2008 (one year before the high-tech swimsuits) and in 2010 (one year after the high tech swimsuits) should be about the same. Table 2 summarizes the results of the various paired *t*-tests for the same men and women who competed (and placed among the top 26 in their event's preliminaries) in the NESCAC championships in 2008 and again in 2010 (as well as in 2009). For both men and women, at all four distances, the average drop time in 2008 was no different from what it was in 2010.

Table 3 shows the average time drop differences for men and women in each of the four freestyle events and the differences between them in years with and without the high-tech suits. (A negative entry in this table indicates that the average time drop was greater in either 2008 or 2010 than it was in 2009.) These results show that men experienced significantly bigger time drop differences than their female counterparts from 2009 to 2010. In other words, between 2009 and 2010, the average drop times for women increased while those for men decreased. Still, in other words, the women in 2010 shaved more seconds off their best in-season or seed times relative to 2009 while the men recorded smaller time drop differences in 2010 than in 2009.

Concluding Remarks

The results presented here suggest that the effects of wearing speed suits were more apparent for men than for women. And, although men posted faster times in the 2010 NESCAC championships than they did earlier in the season, their average drop times in 2010 were not nearly as large as they had been the year before (when swimmers were clad in speed suits). And, finally, although no records were kept of who in particular did or did not wear a high-tech suit in the 2009 NESCAC championships, the lack of statistical significance among women swimmers suggests that fewer females wriggled into LZR Racers or Nero Comps.

**Table 1. Summary of Paired *t*-Tests,
2008 versus 2009 and 2009 versus 2010**

	Average Drop Times					
	2008	2009	*p*-value on difference	2009	2010	*p*-value on difference
Men						
50 yards	.461	.801	**.011**[*] (n = 18)	.846	.557	**.004** (n = 16)
100 yards	1.390	1.672	.100 (n = 20)	1.563	1.552	.478 (n = 18)
200 yards	3.711	4.355	.128 (n = 15)	3.929	2.764	**.001** (n = 14)
500 yards	12.667	14.838	**.010** (n = 18)	13.868	12.750	.261 (n = 19)
Women						
50 yards	.495	.523	.391 (n = 15)	.542	.656	.811 (n = 17)
100 yards	.985	1.027	.457 (n = 17)	1.237	1.709	.854 (n = 14)
200 yards	2.282	2.311	.478 (n = 16)	2.370	2.952	.811 (n = 12)
500 yards	7.806	6.447	.806 (n = 18)	7.476	9.758	.897 (n = 18)

[*]Numbers in boldface are significant at better than the .05 level in a one-tailed *t*-test.

Table 2. Summary of Paired *t*-tests, 2008 versus 2010, One Year Before and After the Ban

	Average Drop Times		
	2008	2010	*p*-value on difference
Men			
50 yards	.451	.565	.505 (n = 11)
100 yards	1.093	1.473	.369 (n = 11)
200 yards	2.961	2.594	.592 (n = 7)
500 yards	12.422	12.688	.886 (n = 10)
Women			
50 yards	.502	.410	.587 (n = 7)
100 yards	.685	1.462	.156 (n = 6)
200 yards	2.798	2.386	.719 (n = 5)
500 yards	6.139	7.699	.211 (n = 8)

Table 3. Summary of Two-Sample *t*-Tests,
Average Time Drop Differences Between Men and Women,
2008 versus 2009 and 2009 versus 2010

Average time drop difference between 2009 and 2008

Event	Men	Women	*p*-value on difference
50 yards	.340	.028	.073
100 yards	.282	.042	.591
200 yards	.644	.030	.420
500 yards	2.171	-1.359	.055

Average time drop difference between 2009 and 2010

Event	Men	Women	*p*-value on difference
50 yards	.289	-.114	**.016**[*]
100 yards	.011	-.472	.323
200 yards	1.164	-.582	**.024**
500 yards	1.118	-2.282	.172

[*] Numbers in boldface are significant at better than the .05 level in a two-tailed *t*-test.

References

1. R. Thurow and C. Rhoads, "Fast Times," *The Wall Street Journal*, August 14, 2008, p. A14.

2. NESCAC men's championships. 2008: www.pjmm.net/results/nescacm08/final-results.html ; 2009: www.pjmm.net/results/nescacm09/final-results.html ; 2010: www.nescac.com/sports/swimdive/2009-10/championship/results_m_2010.htm .

3. NESCAC women's championships. 2008: www.pjmm.net/results/nescacw08/final-results.html ; 2009: www.pjmm.net/results/nescacw09/final-results.html ; 2010: www.nescac.com/sports/swimdive/2009-10/championship/results_w_2010.htm .

Footnotes

1. In swimming, the NESCAC schools are: Amherst, Bates, Bowdoin, Colby, Connecticut College, Hamilton, Middlebury, Trinity, Tufts, Wesleyan, and Williams. These eleven liberal arts colleges and universities are located in Connecticut, Maine, Massachusetts, New York, and Vermont.

2. For each event, the top 24 finishers in the preliminaries of the championship meet qualify for the finals. And the winner in the finals scores 24 points for his or her team, the second place swimmer scores 23 points, and so forth down to one point for 24^{th} place. The 25^{th} and 26^{th} place finishers in the preliminaries are placed on reserve and may swim in the finals if any of the top 24 finishers (for examples, due to illness or injury) cannot swim in the finals.

3. It is also important to note that the swimmers from the 2009 championships in the 2008 *v*. 2009 paired comparisons may not be the same swimmers from the 2009 championships included in the 2009 *v*. 2010 paired comparisons.