

# Racing strategy in rowing during Sydney Olympic Games

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## 1 Introduction

Sydney Olympic Games pleased rowers with perfect organization of rowing regatta and beautiful weather. There was only a very light wind on each of the eight racing days, which allows us to compare results directly. Thus, we can conduct analysis of racing strategy, which is not always possible on major world regattas.

Obviously, race strategy is not a dominating factor that determines performance in rowing. Higher physiological work capacity and better technique give undoubtable advantages. However, we observed very tough competition during the Games, where winners and medallists were divided not only by seconds but also by tenth and hundreds of seconds. Under these circumstances no one can say that rowing performances are very different and racing strategy could play decisive role in medals distribution.

Moreover, the latest papers on racing strategy in rowing were published twenty years ago (Klavora, 1980). Two popular racing strategies and some psychological considerations were described in those papers. Leaving them without discussion we will try to analyse the following aspects of racing strategy:

- race types (heats, semi-finals and finals);
- medal winners versus other competitors;
- boat type (singles, pairs/doubles, fours/quads, eights);
- classification of the patterns of racing strategy;
- specific features of the crews from different countries.

## 2 Methods

Analysis of racing strategy was conducted on the basis of official results of Olympic regatta. Split times for each 500 m pieces were analysed. Boat velocity for each quarter of the event was calculated. Ratio of boat speed to “Gold Time” (GT, Table 1) was derived with a purpose of its comparison in different boat types.

**Table 1. “Gold Times” used in this paper**

Boat Type	W1x	M1x	W2-	M2-	W2x	M2x	M4-	LW2x	LM2x	LM4-	W4x	M4x	W8+	M8+
Gold Time (min:sec)	7:12	6:32	6:53	6:14	6:38	6:02	5:44	6:46	6:11	5:48	6:06	5:34	5:54	5:20

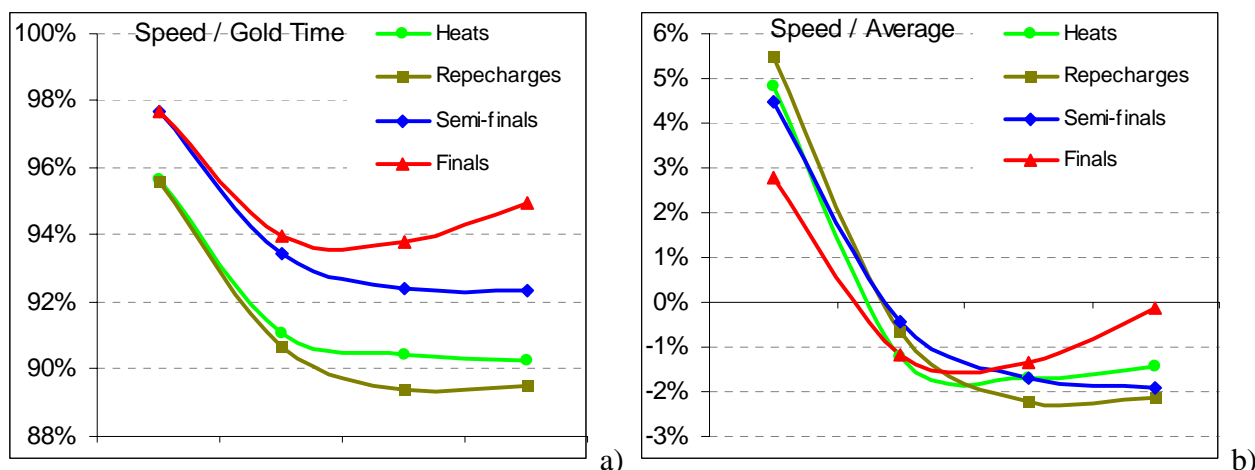
Both boat speed and its ratio to GT are obviously different in wining crews and in slower ones. Therefore, ratio of boat speed at each 500 m to average speed at 2000 m for the same crew was derived. This parameter gives us an ability of a direct comparison of the race strategy in the crews with different level of the boat speed.

Two other parameters were taken into account: difference between the first and the second 1000m of the race and variation of the boat speed, which was derived as a ratio of its standard deviation at four 500m pieces to the average speed for whole race.

## 3 Results and discussion

### 3.1 Race strategy in heats, semi-finals and finals

First of all, let us describe common patterns of race strategy. Figure 1 gives us an idea about the most common patterns of the race strategy. They were significantly different in finals and preliminary races. In finals, boat speed was 2.8% faster than average during the first 500m, 1.2-1.3% slower during the second and third sections and practically equal to average during the final 500m. Preliminary races had relatively faster start (+4.5-5.5%) and slower finish piece (-1.5-2.0%).



**Figure 1. Average race strategy in heats, semis and finals. Percentages to Gold Time (a) and to Average Speed of the same crew (b)**

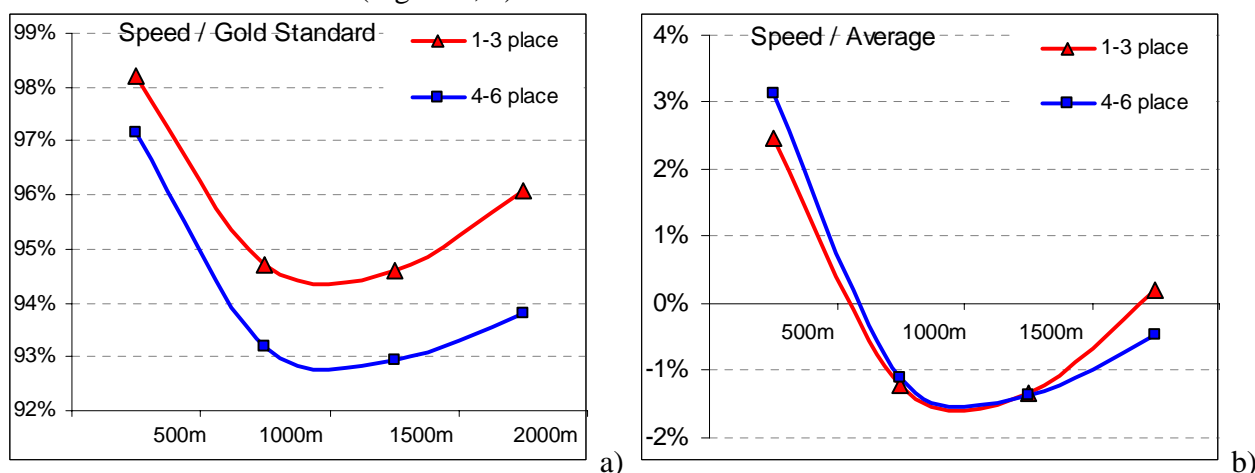
Table 2 shows average boat speed in heats, semis and finals. One can see that average speed increasing from heats to finals, but speed variation decreases along with difference between the first and the second halves of the race.

**Table 2. Average race parameters in heats, repechages, semis and finals**

	n	Average Speed / Gold Time (%)	Difference between first and second 1000m (sec)	Speed Variation (%)
Heats	192	91.77%	6.70	3.15%
Repechages	132	91.21%	8.47	3.46%
Semi-Finals	108	93.90%	6.95	3.15%
Finals	84	95.05%	3.07	2.26%

### 3.2 Race strategy of medal winners

Obviously, average boat speed of the medal winners was higher (Figure 2, a). Race pattern relative to that average speed was quite different as well: winners were on 0.6% slower at start, but they were the same amount faster at finish (Figure 2, b).



**Figure 2. Average race strategy of the medallists and other competitors in finals A. Percentages to Gold Time (a) and to Average Speed of the same crew (b)**

Numbers in Table 3 confirm the above data and highlights that winners had faster second halves of the race and lower variation of boat speed.

**Table 3. Average race parameters of the medallists and other competitors in finals A.**

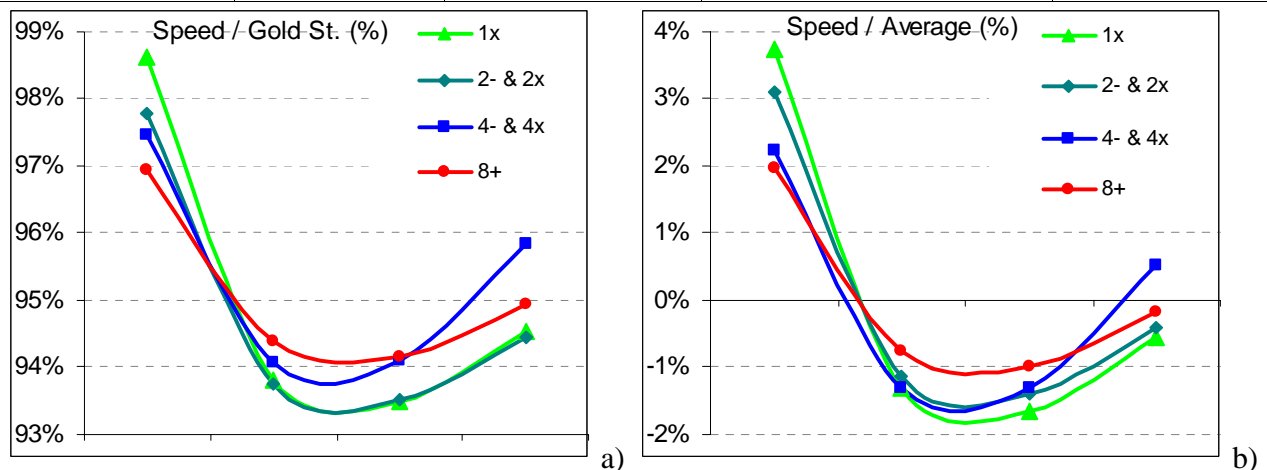
	n	Average Speed / Gold Time (%)	Difference between first and second 1000m (sec)	Speed Variation (%)
1-3 places	42	95.86%	2.32	2.10%
4-6 places	42	94.23%	3.82	2.42%

### 3.3 Race strategy in different boat types

We have found that race strategy depends on boat type. Small boats have faster start piece (Table 4, Figure 3). Bigger boats have lower variation of boat speed and less speed decrease during the second half of the race.

**Table 4. Average race parameters in different boat types.**

	n	Average Speed / Gold Time (%)	Difference between first and second 1000m (sec)	Speed Variation (%)
1x	12	95.06%	4.99	2.81%
2- & 2x	36	94.83%	3.78	2.38%
4- & 4x	24	95.34%	1.54	2.14%
8+	12	95.09%	2.08	1.59%



**Figure 3. Average race strategy in different boat types. Percentages to Gold Time (a) and to Average Speed of the same crew (b)**

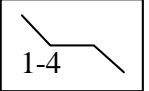

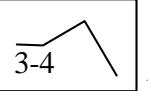

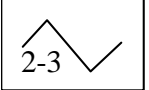
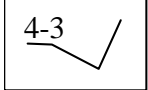
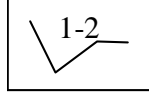
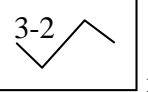
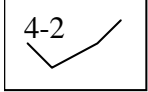
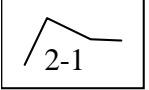
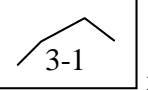
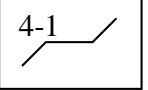
### 3.4 Patterns of race strategy

The above analysis does not define where the races were won and lost. To answer this question we have derived 12 patterns of race strategy.

Firstly, deviation of individual race pattern for each crew was calculated from the average pattern for the same race. Then maximal (relatively fastest piece) and minimal (slowest piece) deviations were found.

Each pattern can be described with two numbers: sequential number of the fastest and slowest 500m pieces. For example: pattern “1-4” means the first 500m was the fastest, whilst the final 500m was the slowest. All 12 patterns are shown in a matrix (Table 5) where each column represents the same fastest piece (from 1 to 4) and each row represents slowest piece.

**Table 5. Matrix of race strategies in finals A. n – number of crew on each strategy. In brackets – number of places on each strategy, ex: (11 3333) means two first places and four third places.**

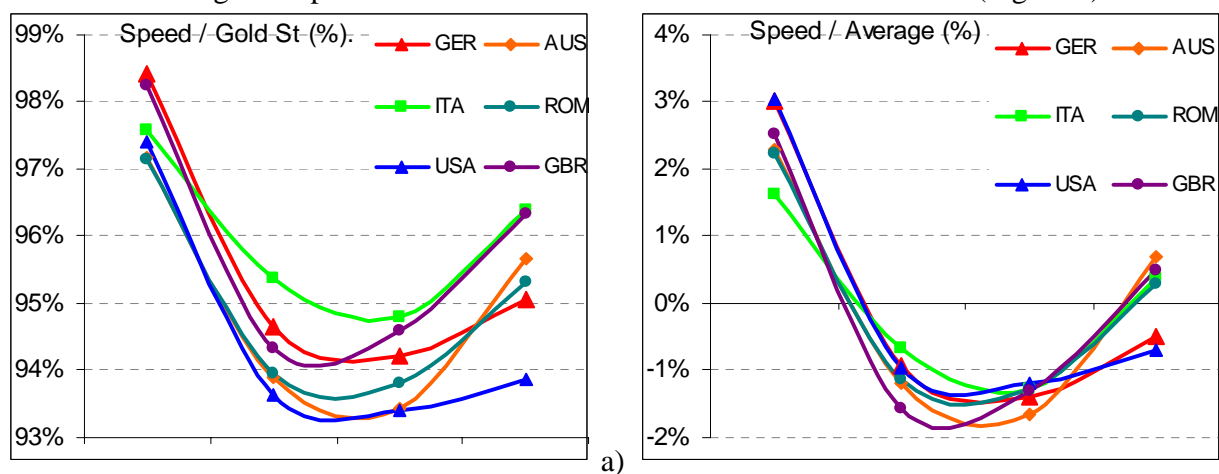
4 <sup>th</sup> 1500-Finish n=26	 n=14 1 3 4 55 6666666666	 n=7 11 2 3 4 5 6	 n=5 1 2 44 5	X
3 <sup>rd</sup> 1000-1500m n=19	 n=9 11 3 4 5555 6	 n=3 22 3	X	 n=7 1 33 4 555
2 <sup>nd</sup> 500-1000m n=13	 n=3 3 4 5	X	 n=3 1 44	 n=7 22 333 5 6
1 <sup>st</sup> Start-500m n=26	X	 n=6 1 2 3 4 5 6	 n=5 1 2 3 44	 n=15 1111 222222 33 44 6
Slowest 500m Fastest 500m	1 <sup>st</sup> Start-500m n=26	2 <sup>nd</sup> 500-1000m n=16	3 <sup>rd</sup> 1000-1500m n=13	4 <sup>th</sup> 1500-Finish n=29

From the matrix we can found that the most popular patterns are two opposite ones: “1-4” and “4-1”. Together these two patterns occurred 29 times that is 34.5% of total number of crews in A Finals. However, performance of the crews with each pattern was opposite as well: pattern “4-1” collected 12 medals out of 15 cases (80%), but pattern “1-4” had only 2 medals out of 14 cases (14%).

The same conclusion could be derived if we take into account closest neighbours of above pattern: the first group with faster first half of the race (patterns “1-4”, “2-4” and “1-3”) and the second group with faster second 1000m (patterns “4-1”, “3-1” and “4-2”). The first group collected 9 medals out of 30 cases (30%) and the second group of patterns got 20 medals out of 27 cases (74%).

### 3.5 Race patterns of different countries

Do the rowers from different countries race according to a specific pattern? To answer this question we derived average race patterns for each of the six most successful countries (Figure 4).



**Figure 4. Average race strategy of different countries in finals A. Percentages to Gold Time (a) and to Average Speed of the same crew (b)**

Results show that rowers from Germany and USA had relatively faster first 500m and slower finish piece. Italians started races slower, but were faster over the second 500m. Britains were slower during the second section and Australians were slower over the third one.

**Table 6. Average race parameters of different countries in A Finals.**

	n	Medals	Average Speed / Gold Time (%)	Difference between first and second 1000m (sec)	Speed Variation (%)
Germany (GER)	9	6	95.54%	3.85	2.29%
Australia (AUS)	10	5	95.01%	2.27	2.18%
Italia (ITA)	6	4	96.01%	1.76	1.64%
Romania (ROM)	5	3	95.04%	1.94	1.76%
USA	9	3	94.53%	3.94	2.33%
Great Britain (GBR)	4	3	95.84%	1.51	2.08%

Table 6 shows that rowers from Italia and Romania had the lowest variation of the boat speed and Germany and USA produced the highest value of this parameter.

#### 4 Conclusion

It is common opinion that even distribution of boat speed during the race is the most beneficial from hydrodynamic point of view. This appears to be true, as telemetry measurement has proved a strong correlation between boat speed variation and its efficiency, i.e. amount of speed lost because of variation. On average, each percent of variation decreases boat speed by 0.25%, i.e. 0.75 sec over 2000 m. Therefore, average 2% of boat speed variation during the race causes a loss of 1.5 sec at finish. This amount of time may appear non significant, however it could prove the difference between a bronze and a gold medal.

Should rowers follow this even pattern of the race strategy? No, they should not do it. Because, two other factors exist, which superimpose influence of the previous one.

The first is a physiological factor. Energy production in rowing is provided from aerobic sources for 70-80%. Quick increasing of oxygen consumption requires significant anaerobic workload at the start of the race. The anaerobic source is more powerful, therefore the first piece of the race should be faster than others. However, it should not be too fast, otherwise rowers must tolerate very high oxygen debt and lactate concentration during the race.

The second is a psychological factor. Rowers can easier control the race get some psychological advantage when they leading the race from the start.

Analysis of the race strategy on Sydney Olympics have confirmed above considerations. The total race pattern during the finals was: +2.8%, -1.2%, -1.3%, -0.1% (speed at each 500m piece relative to average speed during 2000m race).

It was found that race strategy significantly depend on race type (slower finish in heats) and boat type (more even in bigger boats). Some differences were found between race strategies of rowers from different countries. Medal winners had 0.6% slower first 500m and the same amount faster final 500m than other competitors.

New classification of race strategies was established, which consists of 12 patterns. It was found that the most medal winners used patterns with faster finish of the race.

#### 5 References

1. Klavora P., 1980, Two popular racing strategies of international crews: cat and mouse or the favorite's strategy, Catch-Jan/Feb (Canada).
2. Klavora P., 1980, Rowing racing strategy: psychological considerations . Oarsman-12(1), Jan/Feb, 6-11.