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Tactical Analysis of Elite International Women's Eight Rowing

Keke Xia

Competitive Sports Institute, Wuhan Sports University, Wuhan, Hubei, 430079, China

Keywords: Women's Eight Rowing; Tactics; Segment Velocity Structure; Velocity Coefficient; Psychological Breakdown Point

Abstract: This study employs big data analysis to examine the tactical patterns of elite international female rowers, using 500-meter segment times and 50-meter GPS data from 179 Final A races (top 6 finishes) in the World Championships, World Cup, and European Championships over the past decade (2010–2019). By analyzing segment velocity structures and velocity coefficients, the research identifies tactical models. Leveraging digital data collection methods, the study achieves a significantly larger dataset (179 races over 10 years) compared to traditional manual methods (limited to a few races or boats), enhancing the reliability of objective patterns. Key findings reveal that elite athletes adopt a "1-4-x-x" tactical pacing model, with a critical psychological breakdown point at the 450-meter mark. Securing a leading position by 450 meters strongly predicts victory. To support this strategy, the study emphasizes the need for enhanced specialized and foundational physical training, tactical simulations during crew practice, and scientific training monitoring. These measures are expected to significantly improve performance in women's eight rowing.

1. Introduction

Rowing is a physically demanding, cyclic endurance sport where performance improvement relies heavily on physical conditioning and technical proficiency[1]. In recent years, the General Administration of Sport of China has elevated the importance of foundational physical fitness, recognizing it as the cornerstone of athletic capability—a critical prerequisite for mastering technique and a dominant factor in competitive outcomes. Scientific and rational technical-tactical strategies serve as the bridge and window to manifest athletes' physical conditioning[2]. Under equivalent physical fitness levels, effective tactical deployment allows athletes to achieve victory more efficiently and consistently maximize their potential[3].

Optimal energy distribution and full utilization of physical capacity are pivotal to success in cyclic sports. Consequently, most tactical research focuses on race-wide energy allocation. In women's eight rowing with coxswain, this translates to how athletes subjectively regulate stroke rate and power output to modulate boat speed across race segments. Thus, tactical pacing in rowing is fundamentally a matter of speed management[4].

Rowing competitions occur in open-water environments, where performance is heavily influenced by external factors such as wind speed, direction, air temperature, and water

temperature[5]. Notably, rowing does not recognize world records but rather acknowledges world best times. As a result, absolute segment times or velocities alone fail to reveal the intrinsic patterns of competition. Instead, relative speed distribution and proportional contributions across segments offer more meaningful insights. Furthermore, the intensity gap between training and competition renders absolute segment times insufficient for guiding daily tactical preparation. True competitive excellence emerges from athletes' ability to leverage their physical foundation under race conditions[6].

This study analyzes 500-meter segment times and 50-meter GPS data from 179 Final A races (featuring top-six finishes) in major international competitions—including the World Championships, World Cup, and European Championships—over the past decade (2010–2019). By employing a segment-based tactical analysis framework and velocity coefficients, we compare tactical patterns among elite athletes. The research aims to synthesize current advancements and address gaps in tactical studies, ultimately deriving systematic insights into high-level competitive strategies. These findings are intended to strengthen tactical confidence in Chinese women's eight rowing and provide targeted theoretical guidance for coaches in training design.

2. Research Methodology and Subjects

2.1 Research Subjects

This study analyzes 229 top-six Final A races in women’s eight with coxswain from the World Championships, World Cup, and European Championships over the past decade (2010–2019). After filtering out 55 races lacking 50-meter GPS data, valid 500-meter segment times and 50-meter GPS data from 179 races were retained for analysis.

2.2 Research Methods

2.2.1 Literature Review and Data Collection

During the research process, relevant literature—including historical coaching notes, academic papers, and books—was retrieved from physical libraries and digital databases such as CNKI (China National Knowledge Infrastructure) and ResearchGate. This groundwork provided foundational insights and contextualized the study within existing scholarly frameworks, fostering new ideas rooted in historical knowledge.

2.2.2 Expert Interviews

To enhance the practical relevance and theoretical rigor of the study, structured interviews were conducted with elite Chinese rowing coaches, sports scientists, and fitness specialists. Their expertise enriched the interpretation of data and bridged gaps between empirical findings and real-world training applications[7].

2.2.3 Statistical Analysis

Publicly available race data were systematically collected, cleaned, and analyzed using Python and Microsoft Excel 2016. Advanced statistical tools enabled the extraction of patterns and relationships from the dataset, facilitating both visual interpretation (e.g., heatmaps, trend graphs) and quantitative modeling to uncover hidden tactical trends.

2.2.4 Logical and Comparative Analysis

By synthesizing historical research, expert insights, and statistical outcomes, a logical framework was developed to identify tactical pacing patterns in women's eight rowing. Visualization techniques (e.g., velocity distribution curves, pacing heatmaps) were applied to generalize findings and derive actionable conclusions about optimal race strategies.

3. Results and Analysis

3.1 500-Meter Segment Velocity Structure

Drawing on established methodologies from domestic and international rowing tactical studies(Figure 1), the 2000-meter race distance is conventionally divided into four 500-meter segments. The fastest and slowest segments are identified, and their order of velocity (reflecting energy allocation) is represented numerically (e.g., "1-4-2-3" indicates the first 500 meters as the fastest, the fourth as the second fastest, and the third as the slowest). This notation system characterizes a crew's tactical energy distribution strategy. Analyzing the 179 women's eight finals, ranked left to right by total race time (fastest to slowest), a clear pattern emerges: nearly all crews exhibited their highest velocity in the first 500 meters ("1-x"). The dominant tactical model across the dataset is "1-4-2-3," where crews start with maximum effort in the first segment, maintain moderate intensity in the fourth and second segments, and conserve energy in the third[8]. This pattern, evident across the large dataset, unequivocally delineates the tactical framework adopted by elite international women's eight crews.

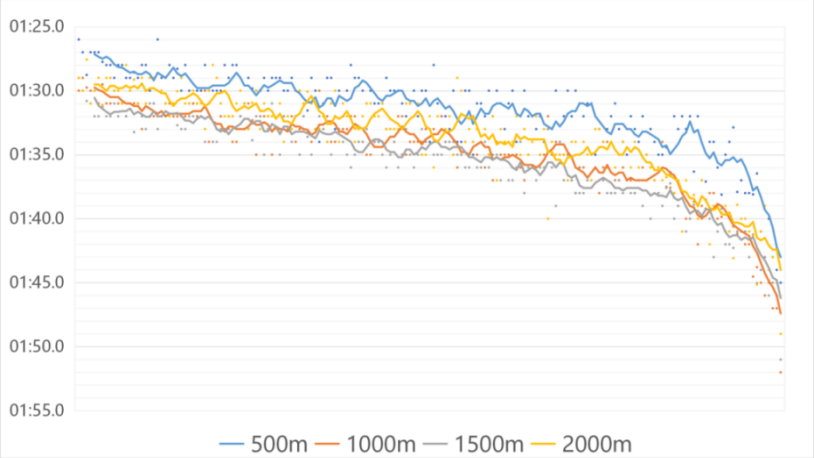


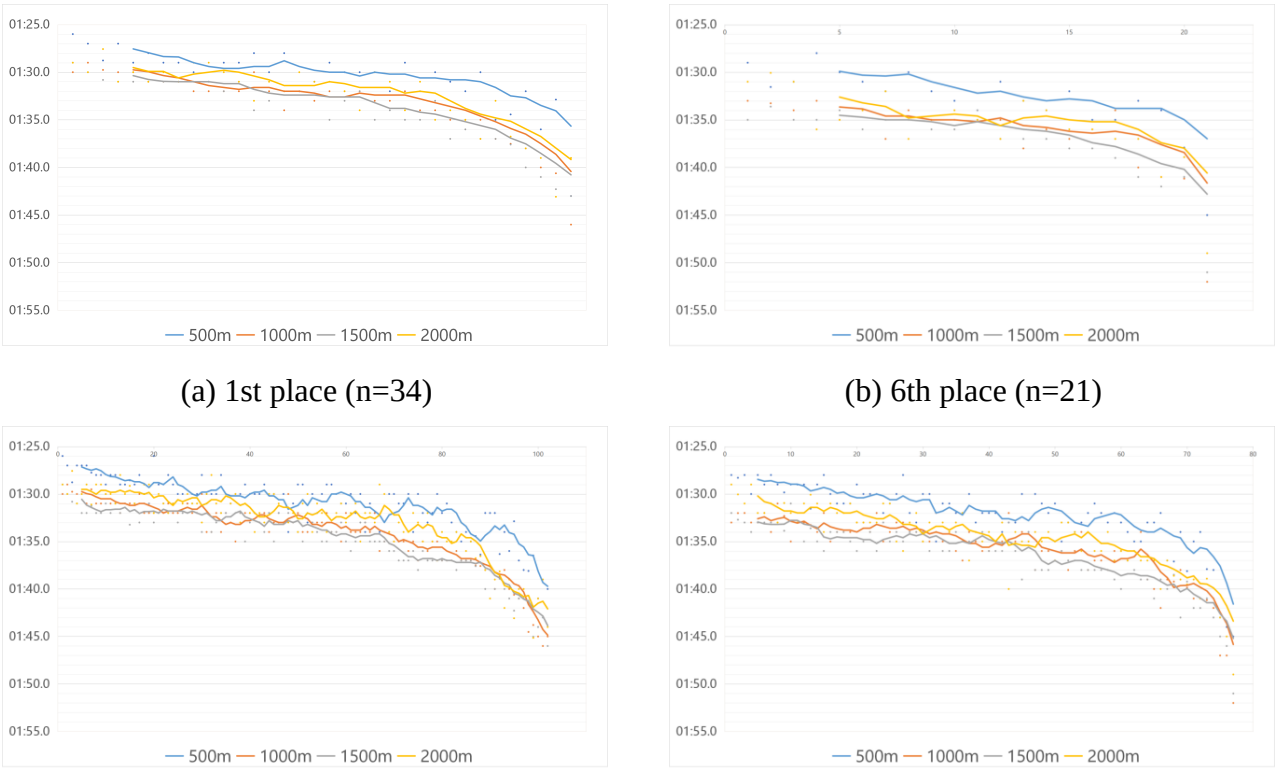
Figure 1 Statistical chart of 1-6 winners in the competition (n=179)

3.2 Analysis of Ranking-Specific Patterns

A notable disparity emerged between winning crews (1st place) and sixth-place crews in terms of pacing consistency (Figure 2). Winning crews demonstrated relatively balanced velocity distribution across all four 500-meter segments while maintaining the fastest pace in the first segment. In contrast, sixth-place crews exhibited greater variability in segment velocities, with significant fluctuations between the fastest and slowest sections. This trend was further evident in comparative analyses between crews ranked 1st–3rd and those in 4th–6th places, where higher-ranked crews consistently displayed more stable pacing strategies.

These findings align with the 2015 study by Zi Wei on the 12th Liaoning National Games, which identified similar tactical patterns in cyclic endurance sports. The consistency observed among top

performers adheres to the physiological principles of energy system dynamics in rowing: optimal pacing minimizes premature fatigue and ensures sustained power output, whereas erratic speed distribution correlates with inefficient energy utilization and performance decline.



(a) 1st place (n=34)

(b) 6th place (n=21)

(c) 1st - 3rd place (n=102)

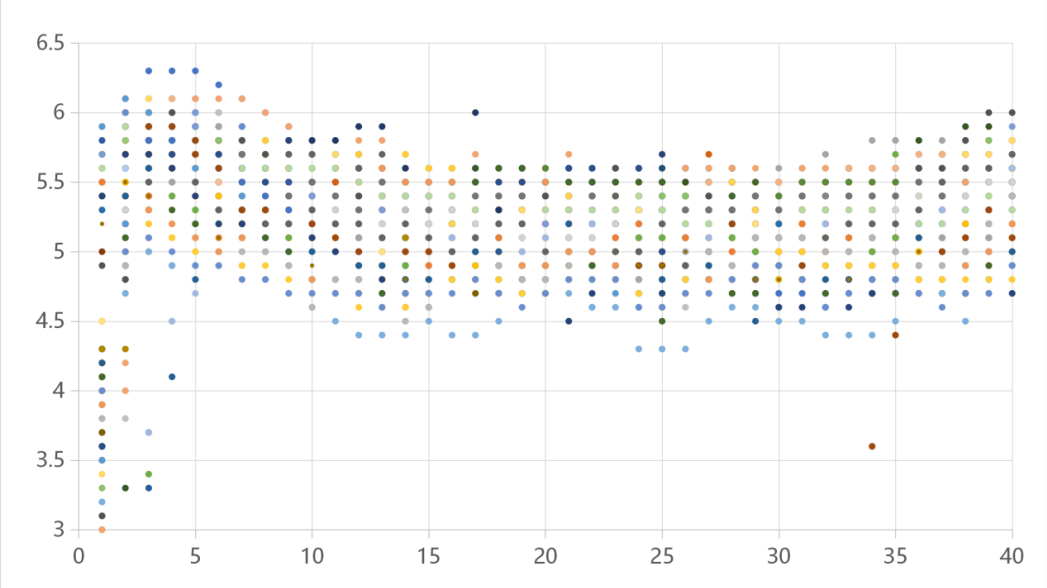
(d) Places 4-6 (n=77)

Figure 2 The statistical chart of 1st to 6th place in the competition

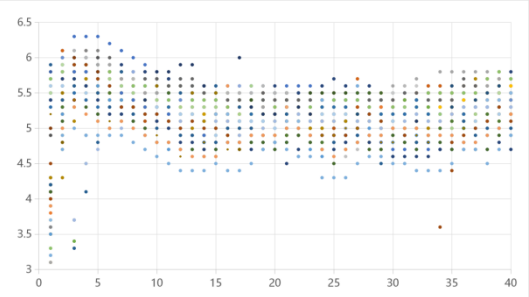
3.3 50-Meter Segment Velocity Structure

Next, the 179 women's eight finals were analyzed using 40 consecutive 50-meter GPS velocity segments (units: m/s) spanning the full 2000-meter race distance (Figure 3). The data reveals a consistent tactical pattern: peak velocities predominantly occur between 150–300 meters, followed by a secondary surge in the final 100 meters (1900–2000m). During the intermediate phases, crews generally maintain stable speeds with minimal fluctuations.

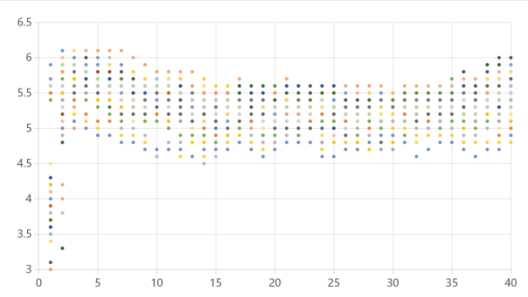
This bimodal pacing pattern—characterized by an early acceleration phase and a strong finish—aligns with the physiological demands of rowing, where athletes balance anaerobic bursts with aerobic endurance. The initial peak likely reflects crews establishing race dominance, while the late-stage surge capitalizes on residual energy reserves to secure or improve positions.



(a) 1-6 (n=179)



(b) 1-3 (n=179)



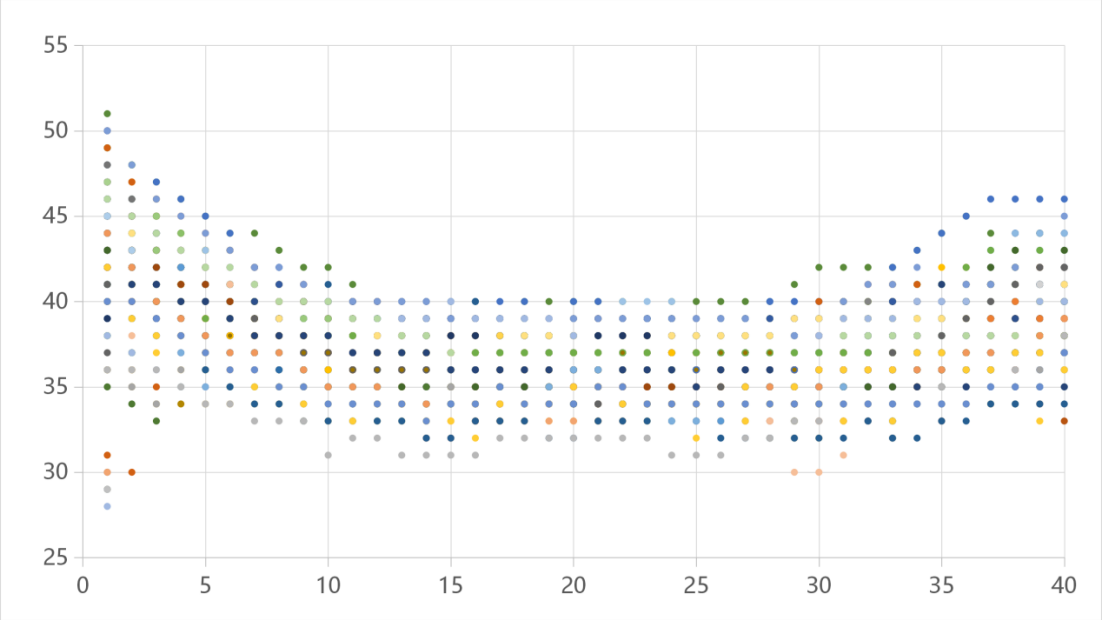
(c) 4-6 (n=179)

Figure 3 GPS speed data statistics in the race

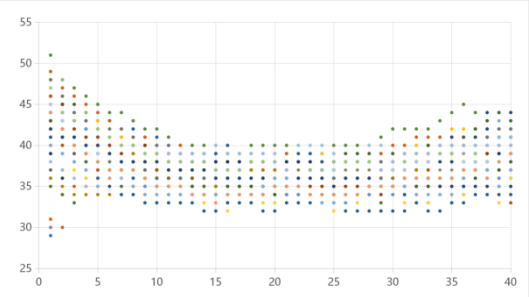
3.4 50-Meter Segment Stroke Rate Structure

Further analysis of the 179 women's eight finals was conducted using 40 consecutive 50-meter GPS stroke rate segments (units: strokes per minute, spm) across the 2000-meter race (Figure 4). Stroke rate serves as a subjective indicator of energy allocation intent, less influenced by external factors (e.g., wind, water conditions) than actual boat speed, making it a more direct reflection of tactical decision-making.

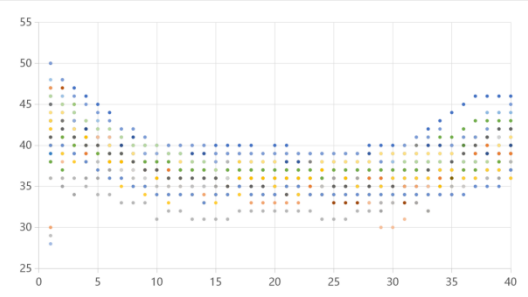
Key findings reveal a consistent tactical template: Peak stroke rates occur within the first 200 meters (0–200m), enabling crews to establish early momentum. A gradual decline follows, stabilizing until the 500-meter mark, where stroke rates are tactically increased for mid-race positioning. A final sprint is initiated in the last 250 meters (1750–2000m), marked by a sharp rise in stroke rate, while intermediate segments maintain relative stability. This pattern underscores a three-phase strategy: aggressive initial pacing, conservative mid-race management, and a decisive finish. The alignment between stroke rate adjustments and race phases highlights crews' deliberate energy conservation and redistribution to optimize performance.



(a) 1-6SR



(b) 1-3SR



(c) 4-6SR

Figure 4 GPS speed data statistics in the race

3.5 Speed coefficient of 50 meters

The concept of speed coefficient is introduced in order to analyze the tactical distribution and psychological state of athletes with different rankings more clearly (Figure 5). This concept was proposed by Yuan Junxiang to study the tactics of rowing. This paper has made a more detailed analysis from the perspective of predecessors, and the data accuracy has been improved to 50 meters, 10 times that of the original 500 meters.

The speed coefficient is defined as: representing the average speed of the whole race; Represents the average speed of the segment.

The speed coefficient is a dimensionless coefficient, which uses the average speed of the boat itself as the measurement standard, indicating the difference between the speed of each section and the average speed of the whole 2,000m. It has nothing to do with natural environmental factors or the basic physical ability of the athlete, but only has something to do with the speed of the athlete's own boat. Therefore, this index can reflect the subjective physical distribution of the race boat in the whole race process.

We compare the athletes ranked 1st with those ranked 2-6 respectively. We can see that the 1st player assigns more efficiency in the first 450 meters than those ranked 2-5, while the 6th player shows more distinct characteristics compared with the 1st player. The main reasons for this are as follows: 1) He wants to seize other opponents; 2) Physical support on the way; 3) The conversion

efficiency of technology is not high.

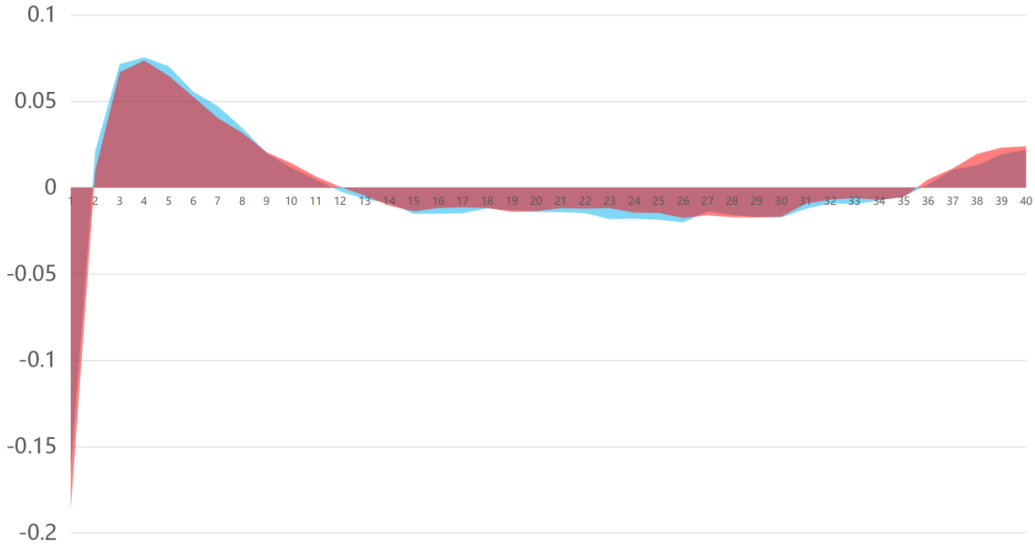


Figure 5 Analysis diagram of different positions in the competition

4. Conclusions and Suggestions

4.1 Conclusion

1) In the women's eight-man single paddle race with coxswain, the top six boats in the World Cup, World Championship and European Championship in the past 10 years almost all chose the "1-4-2-3" tactic, that is, the first 500 meters are the fastest, followed by the last 500 meters, the second 500 meters, and the slowest is the third 500 meters[9].

2) There is a significant difference in the dispersion degree between the champion boat and the sixth boat, that is, the champion boat is more average in each section under the condition that the first 500 meters is maintained as the fastest; The e speed of the sixth place boat was more different and more spread out[10].

3) The final boats almost always show the fastest speed between 150-300 meters, and the second highest speed in the last 100 meters (1900-2000m), and basically maintain stability on the way.

4) The 1st runner was assigned more efficiency in the first 450 meters than the 2-5 runners.

4.2 Suggestions

1) Focus on the lead in the first 450 meters.

2) In the case of ensuring the lead in the first 450 meters, distribute the energy evenly as far as possible.

3) In the past two years, the adoption of catfish policy in China has exerted external pressure on members of the national team and increased the intensity of competition in the first 500 meters, which is consistent with the conclusion of this paper.

4) In order to support the implementation of tactics, it is necessary to strengthen special physical fitness and basic physical training, drill competition tactics in daily joint training, and need scientific training monitoring means, which will be of obvious benefit to the growth of women's eight boat sports performance.

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