Intra-Race Position for Medal Winners in the Track Endurance Events at the 2008 Olympic Games

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ABSTRACT

The aim of this study was to determine how intra-race positioning and finishing sprint ability were related to the final rank order finishes of competitors in the track endurance events at the 2008 Olympic Games. Split times for each 100m were obtained for all men's and women's 800m to 10,000m finalists and mean race position over each fifth of the race was calculated, with the exception of the 800m for which fourths were calculated. It was found that position or racing strategy is different between events and sexes. Medallists in the shorter events (i.e., 800m and 1500m) typically move into medal position earlier than those in the longer events. Medallists in the longer men's events tend to rely on finishing sprint ability to achieve their final position while women medallists generally move into medal position earlier in the race.

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Introduction

In elite competitive distance running an athlete attempts to achieve two main performance outcomes. The first is to record the fastest time possible, e.g. personal or world record, and the second is to win the race and or defeat as many competitors as possible. However, obtaining both of these outcomes in the same event rarely occurs. This is most likely due to the differing strategies undertaken as a function of what the most desired outcome is for that competition (i.e., best time or best place). The desired performance outcome typically depends on the time of season, the nature of the competition, and often the incentives – financial or otherwise.

Strategies differ when competitive outcomes are primarily determined by performance time. The optimal pacing strategy resulting in the fastest possible competitive performance has received minimal observation [1, 2]. An even pace throughout the entire race has been suggested to be the best strategy for the fastest possible time in longer duration events (i.e., 5000 and 10,000m) [1]. In contrast, a positive pacing strategy in which the athlete achieves peak speed early in the race and then progressively slows until the finish of the race was suggested to result in faster performances in shorter events (up to 800m) [1].

However, in world-level championship events (i.e., the IAAF World Championships in Athletics or the Olympic Games) the primary performance goal is to win the race, qualify for the next round, or win a medal in the final. A completely different pacing strategy may be required than that taken by the athlete attempting to achieve the fastest time. Winning or medalling at this level often requires execution of a tactical or racing strategy. Further, the winning athlete is often the one who most effectively executes his/her racing strategy. Obviously talent, training, and natural ability play a role in success, but athletes at the highest level often are relatively equal in these characteristics. Therefore, racing strategy may ultimately determine competitive outcomes.

Beginning in the early 1970's women began to enter competitive sports, specifically track and field. During this period the world records differed between men and women by approximately 20% for events ranging from the 1500m to the 10,000m [3]. At present the difference between men's and women's world records are approximately 10–13% [3]. From the perspective of athletic performance, females are considered to be quite different physiologically, from males [4]. Differences include metabolic capacity (e.g., VO_{2max}), pulmonary structure and function, body composition, hormonal profiles and skeletal traits [4]. These physiological differences collectively could account for the differences in athletic performance (e.g., world record times). However, while considerable research attention has been given to sex differences on a variety of physiological parameters, no investigations have focused on potential pacing strategy differences between males and females.

Furthermore, to our knowledge there have been no studies that have examined the racing strategy of endurance athletes, regardless of sex, at major international competitions such as the Olympic Games. While previous research has analysed pacing in world record performances, a similar analysis has not been performed on competitions where finishing place may be as important as the actual timed performance [1]. The general perception appears to be that many Olympic finals in the longer races are won by athletes who remain back in the pack early in the race and then utilise a fast finishing kick. In contrast, the winners in the shorter races appear to run at the front throughout the race. This perception has not been examined rigorously. Therefore, the purpose of this investigation was to determine how intra-race positioning and finishing sprint ability were related to the final rank order finishes of runners in the track events at the 2008 Olympic Games. This analysis was made in an attempt to determine whether or not a clear pattern of racing strategy emerged within the medallists. A secondary purpose was to investigate a potential difference in pacing strategy between sexes. We hypothesised that medallists in the longer events (e.g., 5000m and 10,000m) would demonstrate positioning further back in the pack during the early portions of the race, compared to athletes in the shorter events (e.g., 800m and 1,500m). Similarly, we hypothesised that men and women would utilise different pacing strategies given the obvious differences in important physiological characteristics dictating running performance.

Method

Data from the 2008 Olympic Games in Beijing was obtained from information publically available on the IAAF website [5]. Data was provided to the IAAF by ST Sportservice

GmbH (Swiss Timing, Corgemont, Switzerland). Briefly, each athlete in all distance events had a wireless transponder placed in their bib number, which was pinned to their chest. Transponder antennae were placed at each of four 100m points on the track, equidistant from the finish line. Split times for each athlete were wirelessly recorded for each 100m segment, with times recorded to the 0.1 second.

Split times were analysed for all competitors in the final round of the 800m, 1500m, 5000m, and 10,000m events for both sexes. The 3000m steeplechase event was not analysed, due to the asymmetrical distance of each split obtained. For analysis of the effect of intra-race positioning on overall placing, the 1500m, 5000m, and 10,000m events were divided into quintiles (fifths), while the 800m was divided into quartiles (fourths). Athlete rank order position at each quartile or quintile was determined, based on the 100m race splits. For further analysis, athletes were divided into three groups based on finishing place: medallists (1^{st} through 3^{rd}), 4^{th} through 6^{th}, and 7^{th} through 9^{th} places. To determine the influence of finishing kick ability on overall placing, the final 200m split for each athlete was determined and placed in rank order.

Data was compared using several mixed method analysis of variance (ANOVA) procedures. ANOVAs used were both two- and three-way in design. This was done to analyse differences between events, time points, and sexes. If the omnibus tests resulted in a significant effect, Tukey's HSD post hoc test was used to elucidate the means that were significantly different. All statistics were computed using the Predictive Analytic SoftWare (PASW; formerly SPSS) version 17.0 (IBM, Chicago, IL).

The present study was undertaken as a qualitative study to observe how athletes at the top level of distance running obtain an Olympic medal. Therefore, statistics were undertaken as an aid to describe how these athletes raced and also demonstrate how and if medallists between events were different.

Results

Figure 1 displays the mean rank (i.e. position in the race) for the medallists across each quintile (1500m – 10,000m) or quartile (800m) for both men (1A) and women (1B). For the men there was a significant difference between the 800m and 10,000m, as well as between the 5000m and 10,000m. Athletes in the 10,000m had a higher rank in the early portions of the race, compared to men's medallists in the 800m and 5000m. For the women a similar analysis resulted in a significant difference between the mean ranks at each segment of the 800m and 5000m, as well as, a significant difference between the 1500m and 5000m. As with the men, medallists in the 5000m had a higher rank in the early portions of the race, compared to the shorter events. Statistical analysis of the events showed there to be no significant difference between sexes ($p = 0.744$).

The percentage of the race spent in medal position for each group (e.g., medallists, finishers 4^{th} – 6^{th}, and finishers 7^{th} – 9^{th}) and each event was calculated (Figure 2). Planned comparisons were performed between all events (e.g., men's 800m vs. men's 1500m, men's 800m vs. men's 5000m, etc.). Analysis revealed there to be significantly more time (as a percentage of the race) spent in medal position by the medallists for the men's 800m compared to the men's

Table 1: Rank of the final segments for the 2008 Olympic Champion in the men's (M) and women's (W) middle- and long-distance events

	Last 400m	Last 200m	Last 100m		Last 400m	Last 200m	Last 100m
M 800m	4	4	5	**W 800m**	1	3	3
M 1500m	1	2	5	**W 1500m**	1	3	3
M 5000m	2	5	9	**W 5000m**	1	1	1
M 10,000m	1	1	5	**W 10,000m**	1	1	1

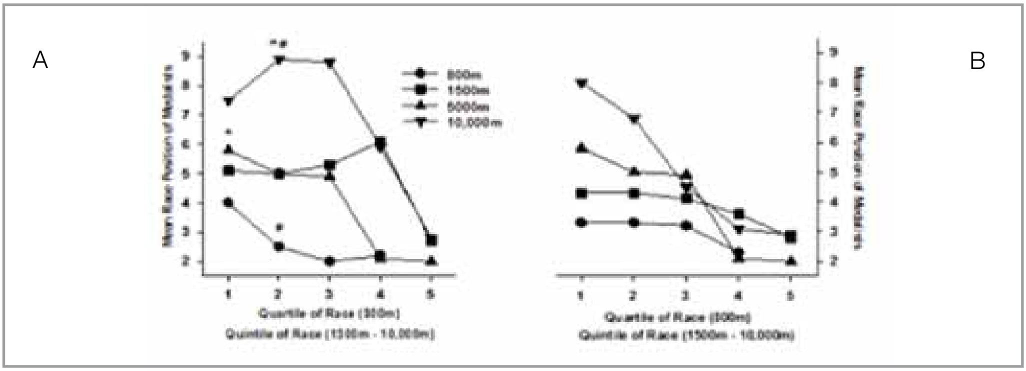

*Figure 1: Mean race position of the medallists at each quintile (1500m – 10,000m) or quartile (800m) for both men (A) and women (B) in the middle- and long-distance races at the 2008 Olympic Games (For the men, the * and # denote events that are significantly different from one another. For the women, the * and # also denote events that are significantly different from one another. No significant difference between sexes was present (p = 0.744).)*

1500m and 10,000m. However, no significant differences were present between the women's events or between sexes (p = 0.681).

The rank of the final 200m for each ***group*** (e.g., medallists, finishers 4th – 6th, and finishers 7th – 9th) and each ***event*** for both sexes were calculated. The results are displayed in Figure 3. For the men, significant main effect for event and group (p = 0.008 and p < 0.0001, respectively) were present. However, there was no significant interaction effect (p = 0.539).

For women, there was a significant effect for group (p < 0.0001), a significant trend for event (p = 0.054), but no significant interaction (p = 0.624).

However, no difference existed between sexes (p = 0.744). Additionally, the rank of the final 200m split was determined for the Olympic champion in each of the eight events studied, with the results displayed in Table 1. Note that in only three of the eight races did the winner have the fastest final 200m split.

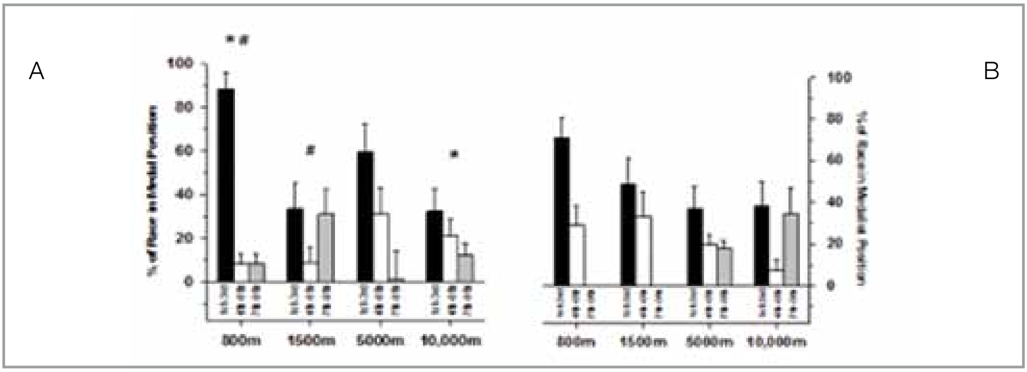

*Figure 2: Percentage of the race that each group (e.g., medallists, finishers 4th – 6th, and finishers 7th – 9th) for each event spent in medal position in the middle- and long-distance races at the 2008 Olympic Games (Figure A displays the results for the men and B displays the results for the women. The * and # denote events that are significantly different from one another. No significant difference was present between sexes (p = 0.681).)*

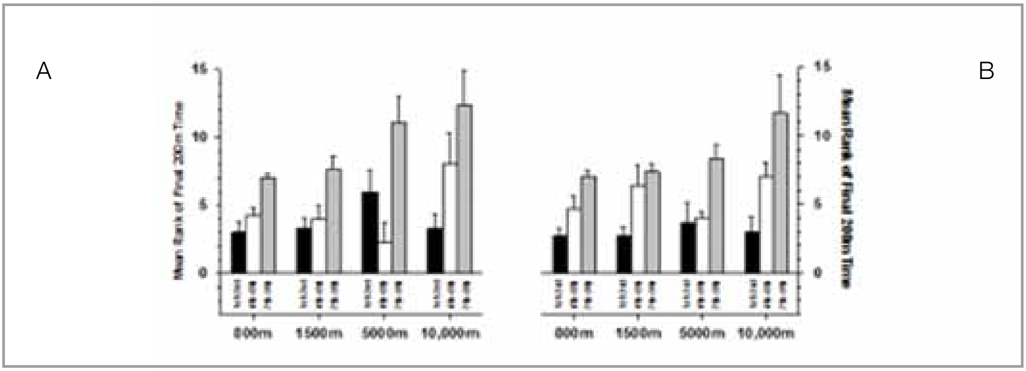

Figure 3: Mean rank of the final 200m of the race for each group (e.g., medalists, finishers 4th – 6th, and finishers 7th – 9th) and for each event in the middle- and long-distance races at the 2008 Olympic Games (No significant difference was present between men and women (p = 0.744). Results and displayed for men (A) and women (B).)

Discussion

The principle purpose of this investigation was to determine how intra-race positioning and finishing sprint ability were related to the final rank order finishes of track athletes in the distance events at the 2008 Olympic Games in Beijing. A secondary purpose was to compare race strategies between men and women runners. The results of this study suggest that there are different racing strategies between the shorter and longer distance events. These findings were consistent between sexes.

Based primarily on anecdotal evidence, we hypothesised there would be a difference in racing strategy (i.e., intra-race positioning) between the shorter and longer events (e.g., 800m compared to 10,000m). It was thought that athletes that medalled in the shorter events (middle-distances) would place themselves early in medal position (top 3) and attempt to stay in that position throughout the entire race. Whereas, in the longer events the medallists were out of the top 3 for the majority of the race and relied entirely on finishing sprint ability (usually over the final fifth of the race) to obtain a medal. The present results support this hypothesis.

There are two main performance objectives that athletes in track and field attempt to achieve that may or may not be mutually exclusive. These are running the fastest time possible and winning the race. Again, in many championship races (e.g., the Olympic Games, IAAF World Championships in Athletics) the primary objective appears to be obtaining a medal. Therefore, the athletes must construct a racing strategy that will give them the best chance of finishing in one of the top three places. CHAPMAN [6] suggests that there are four general racing strategies that athletes employ in the distance events. These strategies are Leader, Kicker, Pacer, and Breaker. First, using a "Leader" strategy requires that a runner take the lead immediately from the start or at some point early in the race. This is done as a means to control the pace of the event and either "run away" from the other competitors or "burn up" the finishing ability of the other runners. The next strategy, the "Kicker," entails expending as little energy as possible not leading the race, and then using strong finishing speed to ultimately win. The "Pacer" will attempt to estimate a priori the time required to win the race and then execute even splits for as long as possible to achieve that estimated winning time. Finally, the "Breaker" is a strategy whereby the athlete will attempt to "break open" the race by using an increased pace in the middle of the race. This is done in an attempt to catch others off guard and based on the response from the other competitors, invoke the appropriate pacing to win the race from that point on [6].

Based on the results of the present analysis (see Figure 4) and Chapman's pacing paradigm [6], it appears that athletes in the shorter distance events utilise a strategy that closely resembles that of the "Leader" described above. For example, the medallists in the men's and women's 800m had a mean rank of approximately 4 during the first quarter of the race (200m) and maintained or improved this rank throughout the event (see Figure 1A). A similar pattern is observed in both the men's and women's 1500m. The strategy the medallists seem to utilise is a combination of the "Leader" and the "Kicker". The women held a constant mean rank throughout the duration of the event while the men had a little bit higher (worse) rank (about 4 and 5 respectively). In contrast, the medallists in the longer distance events appear to primarily utilise the "Kicker" or "Breaker" strategies described above. These athletes tend to stay relatively far away from medal positions through the early and middle portions of the race and then "kick" to place (see Figure 1A). However, sometimes the winner and/or medallists will utilise a "Breaker" strategy. This can be seen in the men's 10,000m where the gold medallist led a large portion of the final few kilometres and outsprinted the others for the win.

Medallists in the longer events have a significantly higher mean rank over the duration of the race than those in the shorter events. It is generally accepted that following is less energetically costly than leading, and therefore it makes logical sense those athletes that medalled in the longer events would stay out of the lead for the majority of the race (i.e., "Kicker"). McCOLE et al. [7] studied the energy expenditure during bicycling. The authors found there to be no difference in VO_2 when cyclists were being led by 1, 2, or 4 other cyclists. However, there was a significant reduction in VO_2 when cyclists rode in a pack. When riding at 40 km/h VO_2 was reduced by 39 ± 6% when riding in a pack compared to riding behind 1, 2, or 4 riders. Although this study was done in cyclists it is relevant to the present investigation as it demonstrates a lower metabolic cost to follow when compared to leading. Similarly, DAVIES [8] measured the VO_2 of runners with varied wind resistances (1.5 – 18.5 m/sec). The author showed that VO_2 increased linearly over the lower wind velocities and increased curvilinearly over the faster wind velocities. Similarly, MORGAN & CLAIB [9] suggest that running while following one and two metres behind another runner can save 6% and 3% of energy respectively. These studies support the supposition that leading is more energetically costly than following (i.e., drafting). Therefore, it makes strategic sense for runners in the longer distances to stay further away from medal position during early stages of the race.

There are admittedly several weaknesses inherent in this analysis. One limitation of this study is the small sample size. In all events a sample size of less than ten runners (and of course only three medallists) was present. This greatly reduces the statistical power that can be obtained and thus makes it difficult to ob-

Event	Men	Women
800m	Leader	Leader
1500m	Leader/Kicker	Leader/Kicker
5000m	Kicker	Kicker
10,000m	Kicker/Breaker	Kicker/Breaker

Figure 4: Preferred racing strategy for each middle- and long-distance event at the 2008 Olympic Games based on the racing strategy paradigm proposed by Chapman [6]

serve statistical differences when making comparisons. However, the purpose of this investigation was not to show statistical differences *per se*, but to describe what the top middle- and long-distance athletes were doing to earn a medal at the Olympic Games in Beijing.

A second limitation is represented by attempting to compare events with a different numbers of competitors. For example, in the 800m final there were only eight athletes whereas there were 35 finishers in the 10,000m. Specifically, in Figure 3 the mean rank of the final 200m was examined. No statistics were reported on this data because the worst (slowest) final 200 in the 800m would earn a rank of 8 whilst in the 10,000m it would earn a 35. Immediately there is a large numerical difference between the two, but practically both hypothetical athletes had the slowest final 200m in their respective events.

How important is the finishing kick to overall competitive success, compared to positioning prior to the kick? Data on the final 200m splits highlight some interesting results. For example, in the men's races, only the winner of the 10,000m had the fastest final 200m kick. Surprisingly, in two of the men's races, the 800m and the 5000m, the winner's final 200m split wasn't even among the top three fastest. This data would suggest that positioning at or near the lead prior to the start of the kick would be more important to winning than the speed of the kick itself. However, this data may be influenced by fact of the winner, with victory in hand, easing off to celebrate in the final metres. In the men's 5000m, the three medallists were well clear of the pack at the beginning of the final 200m, and thus had only the 5th, 7th, and 6th best final 200m splits, respectively. Clearly in this specific event, overall fitness and racing strategy execution over the first 4800m of the race determined the medallists more than finishing sprint ability. However, note for example that in the women's races, only the 5000m and 10,000m winners had the best final 200m splits. Interestingly, the winner of each of the women's 800m, 1500m, 5000m, and 10,000m events had the fastest split over the final 400m. This would suggest that, along with medallists in the women's races tending to get into medal position earlier in the race compared to men, women winners tend to also have the best finishing kicks among competitors in their event. Nevertheless, choosing the best overall pacing strategy, executing that strategy, and final sprinting ability all contribute significant portions to success in championship type races.

Conclusion

This analysis observed a differing strategy between those athletes who are successful in the shorter and longer distance track races at championship type races. Generally, medallists in the shorter races (800m and 1500m) get themselves into medal position earlier in the race, compared to medallists in the longer races (5000m and 10,000m). Runners in the longer races who medal do not get themselves into medal position until the final 20-40% of the race. There were no differences between the men and women, which provides further support to the observations. This suggests that strategy is dictated by the event and that sex does not appear to have an effect on pacing strategy selection. Strategy is influenced by the physiological demands of the event such that, those in the longer events are concerned with energy conservation and those in the shorter events are more concerned with being in an optimal position throughout the event. Finally, CHAPMAN [6] provides a framework to classify events based on the strategy those individuals most often utilise when place is the primary desired outcome.

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REFERENCES

1. TUCKER, R.; LAMBERT, M.I. & NOAKES, T.D. (2006). An analysis of pacing strategies during men's world-record performances in track athletes. International Journal of Sports Physiology and Performance, 2006. 1(3): p. 233-245.

2. TUCKER, R. & NOAKES, T.D. (2009). The physiological regulation of pacing strategy during exercise: a critical review. British Journal of Sports Medicine, 43(6): p. 1-9.

3. SPARLING, P.B.; O'DONNEL, E.M. & SNOW, T.K. (1998), The gender difference in distance running performance has plateaued: an analysis of world rankings from 1980 to 1996. Medicine and Science in Sports and Exercise, 30: p. 1725-1729.

4. WILMORE, J.H. & COSTILL, D.L. (2004). Physiology of Sport and Exercise. 3rd ed. 2004, Champaign, IL: Human Kinetics.

5. IAAF (2009). International Association of Athletics Federations.

6. CHAPMAN, R.F. (2009). Methods of teaching racing strategy for distance runners. Track Coach, 189: p. 6025-6031.

7. McCOLE, S.D.; CLANEY, K.; CONTE, J.C.; ANDERSON, R. & HAGBERG, J.M. (1990). Energy expenditure during bicycling. Journal of Applied Physiology, 1990. 68(2): p. 748-753.

8. DAVIES, C.T. (1980). Effects of wind assistance and resistance on the forward motion of a runner. Journal of Applied Physiology, 48(4): p. 702-709.

9. MORGAN, D.W. & CLAIB, M. (1992). Physiological aspects of running economy. Medicine and Science in Sports and Exercise, 24(2): p. 456-461.