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Champions are racers, not pacers: an analysis of qualification patterns of Olympic and IAAF World Championship middle distance runners

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ABSTRACT

The aim of this study was to analyse qualification patterns in middle distance running and identify whether athletes adopt theoretically optimal tactics, or whether the will to win overrides these. The performances of 295 men and 258 women finalists in the Olympic and IAAF World Championship 800 m and 1500 m events from 1999 to 2017 were analysed across all three rounds of competition. Finishing position, time and ranking amongst all competitors were found for each athlete. Position in the final was correlated with finishing position in the heats and semi-finals (all $P < 0.001$), but not with finishing times in those rounds. Of the 57 champions, 40 won both their heat and semi-final, even though a lower automatic qualification position would have been sufficient, and only 18 achieved a season's best time in the final. The will to win amongst the eventual champions (and other medallists) suggests predominantly ego oriented behaviour that is encouraged by a performance climate, and which did not appear to differ between men and women. Coaches and athletes are recommended to note that championship-specific physiological and psychological factors are important to develop in training and prior competition to improve both short- and long-term championship strategies.

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KEYWORDS
Elite-standard athletes; fatigue; goal orientation; race tactics; track and field

Introduction

In athletics, the 800 m and 1500 m are the two middle distance events contested at the Olympic Games and other major championships. Usually, athletes must negotiate a first round of heats and a semi-final before the final; qualification can be either through achieving a high-enough finishing position or, failing that, by having one of the best finishing times (IAAF, 2017a). Athletes qualifying by time rather than position are often referred to as "fastest losers" (e.g. IAAF, 2017b). The 800 m is the only race distance where athletes must run in lanes (for the first bend), and therefore has a greater restriction on the number of athletes competing in any given round (usually eight), whereas the 1500 m is usually contested by 12 athletes, with more occasionally taking part in the first round. The protocol for the number of heats required (and the number of athletes qualifying either automatically or as fastest losers) is predetermined based on the number of entrants (IAAF, 2017a), and has ranged between 28 and 72 at major championships since 1999 (IAAF, 2018). The process of qualification from the heats usually results in 24 semi-finalists: three semi-finals of eight athletes in the 800 m, and two semi-finals of 12 in the 1500 m. Each qualification round is seeded so that the fastest athletes, and those of the same nationality, are kept separate until the final if possible (IAAF, 2017a).

Unlike the long distance races (5000 m and longer), the middle distance events require greater contributions from anaerobic sources (Lacour, Padilla-Magunacelaya, Barthélémy, & Dormois, 1990), with a much greater reliance on these sources in the 800 m than the 1500 m (Gastin, 2001). The qualification structure used means those athletes who reach the final have already negotiated two rounds, with all three races typically held over four days. The need to recover from each race before the final means that the best strategy for athletes aiming to win a medal is to qualify with the least physiological effort required. Theoretically, the optimal method of achieving this is to finish in the lowest automatic qualification position (e.g. to finish third if there are three automatic qualifier positions) and in the slowest time possible. Part of the skill of championship racing is knowing when to go all out or when to conserve energy in the pursuit of eventual victory (Sailors, Teetzel, & Weaving, 2015), not only during the final but also throughout the multiple consecutive races before it. Pacing has been defined as the way power output is controlled to complete an event in the fastest time possible, having used all available resources (Micklewright, Kegerreis, Raglin, & Hettinga, 2017). Because pacing of this maximal nature would be difficult to sustain across rounds of races, competitors in other multi-stage events, such as grand tours in cycling, instead adopt a long-term approach to distribute their energy reserves in a manner designed to optimise their final competitive result (Foster, Hoyos, Earnest, & Lucia, 2005). It is possible that middle distance runners adopt a similar long-term "championship strategy", although they cannot obtain the same benefits that professional cycling teams provide and, unlike Grand Prix meets, there are no pre-arranged pacemakers to help them achieve fast times. A study of how world-class athletes progress through the qualification rounds, and how this translates into the final, can provide a novel comparison between the championship strategies adopted by eventual champions, medallists, and those finishing outside the top three.

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Despite the benefits of conservative racing in qualification, the competitive nature of sportspeople might mean that many aim to win all their races, regardless of what the optimum strategy is, similar to how endurance athletes do not always implement an even pacing strategy but adopt the same speed as their rivals (Hanley, 2015; Konings, Noorbergen, Parry, & Hettinga, 2016). The motivations of elite-standard athletes range between those related to mastery (task orientation) and those related to winning or beating rivals (ego orientation) (Pensgaard & Roberts, 2002). Being ego or task oriented in sport is not necessarily dispositional (or mutually exclusive), but can depend on the situation (Roberts, 1992). Ego orientation is more likely in sportspeople in a performance climate, which typically occurs when there is interpersonal competition, an emphasis on winning, and public recognition of demonstrated ability (Pensgaard & Roberts, 2002). Given that global championships provide this performance climate, it is likely that many athletes adopt ego oriented behaviours, which could include striving to win all rounds. In addition, men are more likely to be ego oriented in sport than women (Newton & Duda, 1993) and, although Hunter, Joyner, and Jones (2015) suggested that women in general are less fatigable for some activities, there are likely to be minimal differences in elite-standard athletes. Nonetheless, as women have been found to pace themselves better in single-bout long distance events like the marathon (Deaner, Carter, Joyner, & Hunter, 2015; Hanley, 2016), one purpose of this study was to examine whether there are also sex-based differences in qualification patterns. There is a lack of previous research on how elite-standard runners qualify for championship finals even though such research could provide useful insights into the competition strategies used. The aim of this study was to analyse qualification patterns in male and female middle distance runners and identify whether world-class athletes adopt theoretically optimal tactics, or whether there is any indirect evidence that the will to win overrides these tactical ideals.

Methods

Participants

The study was approved by the School Research Ethics Committee. Finishing positions and times of the finalists in the men's and women's 800 m and 1500 m competitions at all Olympic Games and IAAF World Championships between 1999 and 2017 were obtained from the open-access IAAF website (IAAF, 2018). The finalists' finishing positions and times in the heats and semi-finals were also obtained. The finalists were classified as to whether they qualified for the next round as an automatic qualifier (based on position, having finished within those places guaranteeing qualification), a fastest loser (based on time, as one of the fastest athletes not to qualify automatically), or based on an appeal (athletes can progress to the next round if the Jury of Appeal decides they have been obstructed unfairly (IAAF, 2017a)). The original number of starters in each edition of the championships and the number who qualified by each possible method are shown in Table 1 (800 m) and Table 2 (1500 m). The number of athletes qualifying for the semi-finals differed occasionally from the number eventually taking part (as well as between the semi-final and final) as a small number of athletes withdrew from competition between rounds. The performances of 553 athletes were analysed (800 m: 120 men and 117 women; 1500 m: 175 men and 141 women); these included 19 appearances by 16 athletes who were subsequently disqualified. No semi-finals were held for the women's 1500 m in 1999, 2005 and 2008, and so these particular editions of the women's 1500 m have not been included for analysis. In addition, any other finalists who did not have a full complement of results from all three rounds were excluded (comprising four who did not finish the final, two who did not start it, and 11 who progressed after an appeal).

Data analysis

The study was designed as observational research in describing qualification patterns. Competitors in each event were divided into groups based on finishing

Table 1. The number of starters per championship race (N) and the number of athletes qualifying by each method for the next round in the men's and women's 800 m. The total for all analysed championships is also shown.

	Men				Women			
	Heats		Semi-finals		Heats		Semi-finals	
	N	Qualifiers	N	Qualifiers	N	Qualifiers	N	Qualifiers
1999	58	16 Q, 8 q	24	6 Q, 2 q	36	10 Q, 6 q	16	6 Q, 2 q
2000	61	16 Q, 8 q, 1 qJ	25	6 Q, 2 q	38	10 Q, 6 q	16	6 Q, 2 q
2001	36	10 Q, 6 q	16	8 Q	32	12 Q, 4 q	16	8 Q
2003	58	16 Q, 8 q, 1 qJ	25	6 Q, 2 q	40	15 Q, 9 q	24	6 Q, 2 q
2004	72	18 Q, 6 q	24	6 Q, 2 q	43	18 Q, 6 q	24	6 Q, 2 q
2005	50	18 Q, 6 q	24	6 Q, 2 q	37	20 Q, 4 q	24	6 Q, 2 q
2007	47	18 Q, 6 q	24	6 Q, 2 q	45	18 Q, 6 q	24	6 Q, 2 q
2008	58	16 Q, 8 q	24	6 Q, 2 q	42	18 Q, 6 q	24	6 Q, 2 q
2009	49	21 Q, 3 q	24	6 Q, 2 q, 2 qJ	43	18 Q, 6 q, 1 qJ	25	6 Q, 2 q
2011	43	16 Q, 8 q	24	6 Q, 2 q	36	20 Q, 4 q	24	6 Q, 2 q
2012	55	21 Q, 3 q, 1 qJ	25	6 Q, 2 q	39	18 Q, 6 q	24	6 Q, 2 q
2013	47	16 Q, 8 q	24	6 Q, 2 q	32	12 Q, 4 q	16	6 Q, 2 q
2015	44	16 Q, 8 q	23	6 Q, 2 q	44	18 Q, 6 q	24	6 Q, 2 q
2016	57	21 Q, 3 q	24	6 Q, 2 q	65	16 Q, 8 q	24	6 Q, 2 q
2017	47	16 Q, 8 q	23	6 Q, 2 q	45	18 Q, 6 q	24	6 Q, 2 q
Total	782	263 Q, 89 q, 3 qJ	353	92 Q, 28 q, 2 qJ	617	241 Q, 87 q, 1 qJ	329	92 Q, 28 q

Q = Automatic qualifier, q = Qualified as fastest loser, qJ = Allowed to progress to the next round by the Jury of Appeal

Table 2. The number of starters per championship race (N) and the number of athletes qualifying by each method for the next round in the men's and women's 1500 m. The total for all analysed championships is also shown. There was only one qualifying round for women in 1999, 2005 and 2008, and so these particular editions of the women's 1500 m have not been included.

	Men				Women			
	Heats		Semi-finals		Heats		Semi-finals	
	N	Qualifiers	N	Qualifiers	N	Qualifiers	N	Qualifiers
1999	40	18 Q, 6 q	24	10 Q, 2 q				
2000	41	18 Q, 6 q	24	10 Q, 2 q	42	18 Q, 6 q	24	10 Q, 2 q
2001	38	18 Q, 6 q	24	12 Q	38	18 Q, 6 q	22	12 Q
2003	28	18 Q, 6 q	23	10 Q, 2 q	30	15 Q, 9 q	24	10 Q, 2 q
2004	38	15 Q, 9 q	24	10 Q, 2 q	45	15 Q, 9 q	24	10 Q, 2 q
2005	37	15 Q, 9 q	24	10 Q, 2 q				
2007	41	18 Q, 6 q	24	10 Q, 2 q, 2 qJ	36	18 Q, 6 q	24	10 Q, 2 q
2008	50	20 Q, 4 q	24	10 Q, 2 q				
2009	54	20 Q, 4 q	23	10 Q, 2 q	42	18 Q, 6 q, 2 qJ	25	10 Q, 2 q
2011	38	18 Q, 6 q, 1 qJ	25	10 Q, 2 q	34	18 Q, 6 q, 1 qJ	25	10 Q, 2 q
2012	43	18 Q, 6 q, 1 qJ	25	10 Q, 2 q	40	18 Q, 6 q	24	10 Q, 3 q
2013	37	18 Q, 6 q	24	10 Q, 2 q	37	18 Q, 6 q	24	10 Q, 2 q
2015	41	18 Q, 6 q	24	10 Q, 2 q	34	18 Q, 6 q	23	10 Q, 2 q
2016	42	18 Q, 6 q, 2 qJ	26	10 Q, 2 q, 1 qJ	41	18 Q, 6 q	24	10 Q, 2 q
2017	42	18 Q, 6 q, 1 qJ	25	10 Q, 2 q	44	18 Q, 6 q	24	10 Q, 2 q
Total	610	268 Q, 92 q, 5 qJ	363	152 Q, 28 q, 3 qJ	463	210 Q, 78 q, 3 qJ	287	122 Q, 23 q

Q = Automatic qualifier, q = Qualified as fastest loser, qJ = Allowed to progress to the next round by the Jury of Appeal

position, with two groups allocated in the 800 m, and three groups in the 1500 m. These groups were medallists (800 m: 45 men and 44 women; 1500 m: 45 men and 36 women), non-medallists finishing in the top eight ("Top 8" – 800 m: 75 men and 73 women; 1500 m: 74 men and 58 women), and those athletes finishing outside the top eight ("Top 12" – 1500 m: 56 men and 47 women). On the very few occasions where there were more than eight finalists in the 800 m or more than 12 in the 1500 m finals, these athletes have been included in the Top 8 and Top 12 groups, respectively. Comparisons were also made between the performances of the gold, silver and bronze medallists across all rounds (all groups of medallists were N = 15 except for the women's 800 m (14 silver medallists) and the women's 1500 m (N for each medal colour = 12)). Athlete's performances in each round were measured using three outcome variables: their finishing time; their position in the race; and their overall ranking in that round (which is based on all competitors' finishing times). Because the number of starters per event varied between championships (e.g. there were twice as many athletes in the heats of the men's 800 m in 2004 as in 2001), each athlete's ranking was expressed as a percentile based on the total number of starters in that round.

Statistical analysis

One-way repeated measures analysis of variance (ANOVA) was conducted on the heat, semi-final and final finishing times, with repeated contrast tests conducted to identify changes between successive rounds (Field, 2009). Greenhouse-Geisser corrections were used if Mauchly's test for sphericity was violated. In addition, one-way ANOVA with Tukey's post-hoc tests were conducted to compare finishing times between groups (Field, 2009). Statistical significance was accepted as $P < 0.05$. Effect sizes (ES) for differences between successive rounds, and between groups for each round, were calculated using Cohen's *d* (Cohen, 1988) and considered to be either trivial (ES < 0.20), small (0.21 – 0.60), moderate (0.61 – 1.20), large (1.21 – 2.00), very large (2.01 – 4.00), or nearly perfect (> 4.00) (Hopkins, Marshall, Batterham, & Hanin, 2009). Kendall's tau-b (τ_b) correlations were used to determine the relationships between finishing position in the final with qualification round positional, rank and finishing time data, with Bonferroni corrections used to help avoid Type I errors.

Results

The number of finalists qualifying from the heats and semi-finals as automatic qualifiers, fastest losers and by appeal are shown in Table 3. The number of medallists who won both their heat and semi-final, either their heat or semi-final (but not both), or neither are shown in Table 4. The mean percentile ranking of each grouping in the qualification rounds is also shown. Across the four events, 70% of the 57 gold medallists won both qualification rounds, whereas 36% of the silver medallists and 19% of the bronze medallists achieved the same positions. Despite this, no male medallist (out of 90) was ranked first in both the heats and semi-finals; and out of the 80 women medallists analysed, only two 800 m champions (and one silver medallist) were fastest in both rounds, along with one 1500 m champion. Regarding top-three finishers who did not win both qualifying rounds, 19% of gold medallists won either their heat or semi-final, with 43% of silver medallists and 32% of bronze medallists also achieving this feat. Of the gold medallists, two 800 m men (out of 15) achieved a personal best time (PB) in the final (one also a World Record) and six 800 m women (out of 15) achieved PBs in the final, of whom one had set her previous best in the semi-final. A further four men's champions and three women's champions achieved season's best times (SB) over 800 m. No men's 1500 m champion achieved a PB or SB in the final, although one woman

Table 3. The number of finalists per distance (N) and how many qualified by each method from the heats and semi-finals (including athletes who progressed by appeal, did not start or did not finish the race). The total for all analysed championships is also shown. The finalists who ran in the women's 1500 m heats in 1999, 2005 and 2008 are not included.

		Heats			Semi-finals		
	N	Q	q	qJ	Q	q	qJ
Men's 800 m	122	112	10	0	92	28	2
Women's 800 m	120	110	9	1	92	28	0
Men's 1500 m	183	165	15	3	152	28	3
Women's 1500 m	145	129	14	2	122	23	0
Total	570	516	48	6	487	114	5

Q = Automatic qualifier, q = Qualified as fastest loser, qJ = Allowed to progress to the next round by the Jury of Appeal

Table 4. The number of medallists who either won both their heat and semi-final ("Heat and Semi"), won their heat only ("Heat only"), won their semi-final only ("Semi only") or did not win either qualification race ("Neither"). The values in brackets are the mean ranking (percentile) of those athletes in the qualification rounds (heats/semi-finals). The silver medallist in the women's 800 m was not included as she progressed via an appeal.

	Heat and Semi	Heat only	Semi only	Neither
		Men's 800 m		
Gold	10 (21/17)	4 (13/15)	0	1 (62/17)
Silver	5 (27/14)	6 (33/22)	3 (32/20)	1 (14/8)
Bronze	6 (20/14)	2 (10/25)	3 (34/11)	4 (29/19)
		Women's 800 m		
Gold	13 (21/11)	2 (3/10)	0	0
Silver	7 (16/22)	2 (21/27)	2 (11/4)	3 (27/42)
Bronze	3 (35/24)	7 (17/14)	1 (12/29)	4 (18/29)
		Men's 1500 m		
Gold	12 (19/29)	0	1 (49/42)	2 (22/23)
Silver	4 (32/4)	2 (31/23)	4 (33/22)	5 (22/26)
Bronze	0	1 (55/50)	2 (29/28)	12 (29/36)
		Women's 1500 m		
Gold	5 (14/17)	0	4 (31/29)	3 (19/8)
Silver	4 (39/18)	5 (26/18)	0	3 (24/31)
Bronze	2 (49/43)	0	2 (35/4)	8 (13/23)

winning over the same distance recorded a PB (with two other winners achieving SBs).

Figure 1 shows the mean finishing time for each group of athletes for all three rounds in each event. Differences between successive splits have been annotated when the ES was moderate or larger only; likewise, differences between groups (below) have been included when the ES was moderate or larger only. In the men's 800 m, the medallists were faster than the Top 8 group in the final only ($P < 0.001$, ES = 0.89). Similarly, in the women's 800 m, the medallists were faster than the Top 8 group in the final only ($P < 0.001$, ES = 1.33). In the men's 1500 m, there were no differences between the medallists and Top 8, but both groups were faster than the Top 12 in the final only (medallists: $P < 0.001$, ES = 1.03; Top 8: $P < 0.001$, ES = 0.79). In the women's 1500 m, there were also no differences between the medallists and Top 8, but both groups were faster than the Top 12 in the final only (medallists: $P < 0.001$, ES = 1.56; Top 8: $P < 0.001$, ES = 1.02). There were no differences in finishing time between gold, silver and bronze medallists during any round in any event.

In each event, finishing positions in the final were positively correlated with finishing positions in the heats (men's 800 m: $\tau_b = 0.320$; women's 800 m: $\tau_b = 0.400$; men's 1500 m: $\tau_b = 0.367$; women's 1500 m: $\tau_b = 0.344$; all $P < 0.001$) and finishing positions in the semi-final (men's 800 m: $\tau_b = 0.229$; women's 800 m: $\tau_b = 0.484$; men's 1500 m: $\tau_b = 0.412$; women's 1500 m: $\tau_b = 0.444$; all $P \leq 0.002$). Finishing times in the final were also positively correlated with rankings in the heats in the women's 800 m ($\tau_b = 0.213$, $P = 0.001$) and with rankings in the semi-finals in the men's 800 m ($\tau_b = 0.241$, $P < 0.001$), the women's 800 m ($\tau_b = 0.255$, $P < 0.001$) and the women's 1500 m ($\tau_b = 0.234$, $P < 0.001$).

Discussion

The aim of this study was to analyse qualification patterns in middle distance running and identify whether world-class athletes adopt theoretically optimal tactics, or whether there is any indirect evidence that the will to win overrides these tactical ideals. The correlation between finishing position in the final and position in the heats and semi-finals, coupled with its lack of correlation with times in those qualification rounds, showed that for the best athletes the key motivator was achieving a high position, regardless of the time achieved. For example, the men's 800 m champion in 2015, David Rudisha, won his heat and semi-final but was ranked in the bottom half of all competitors in those rounds. Similarly, it was noteworthy that despite 40 of the 57 gold medallists winning both their heat and semi-final, only three were the fastest ranked in both. This would suggest that champions are able to ensure victory with running speeds much lower than their best by using appropriate and presumably well-practised tactics and thus save their best performances until the final. These tactics are indicative of a longer-term championship strategy that is

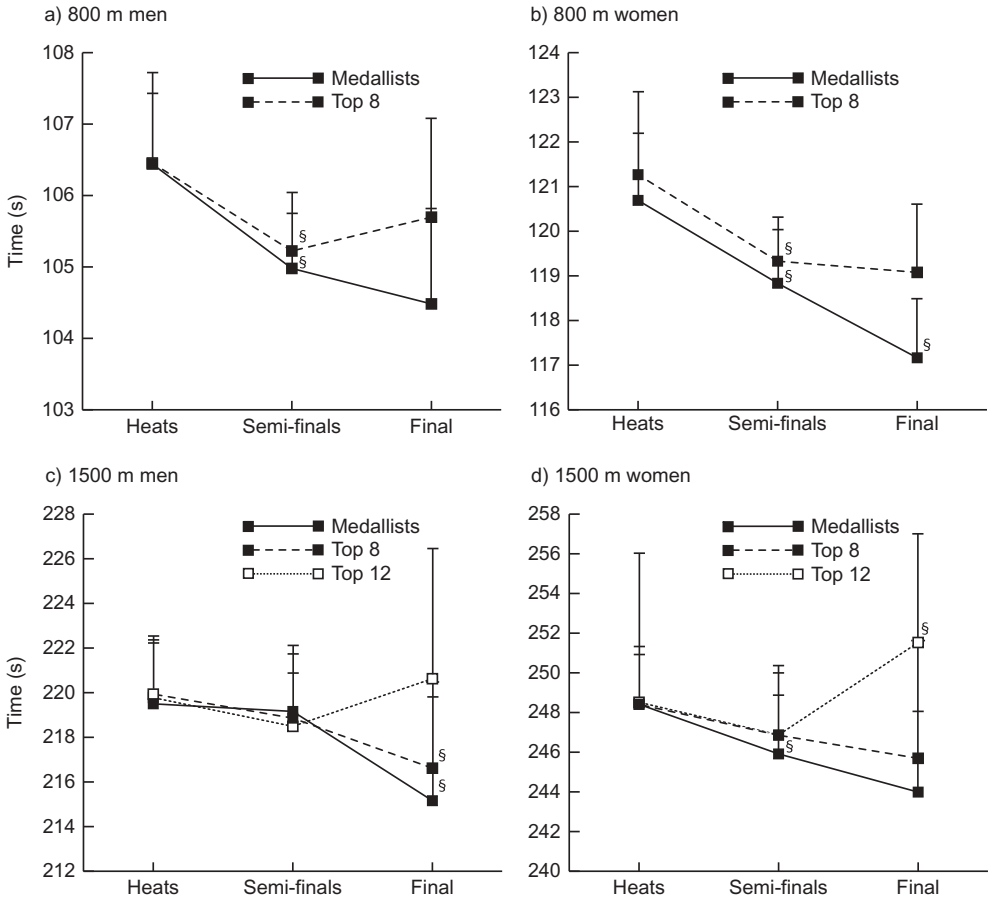

Figure 1. The mean (+ SD) finishing time for each group of athletes for all three rounds in each event. Differences between successive segments with a moderate or larger effect size are shown as $P < .001$ (§).

designed to optimise overall competition success. By contrast, those athletes finishing outside the medals in the 800 m, and those finishing outside the Top 8 in the 1500 m, either maintained their semi-final pace in the final, or slowed. This shows that for these slower athletes, the effort required to reach the final was the limit of their ability and finishing higher in future competitions might require a progression in training regimens or competition strategies.

Although the medallists ran slower in the heats than in subsequent rounds, most eventual champions, and many other medallists, still made sure to win their heats and semi-finals. A theoretically better tactical approach was to save physiological resources by only ensuring a position within the automatic qualification spots. This was especially true of the 1500 m, where in most championships the first six finishers in a heat (and the first five in the semi-finals) progressed as automatic qualifiers. The best athletes therefore overcame a potential conflict in their racing by running quickly enough to win (short-term optimal pacing) but slow enough to prevent excessive fatigue (a longer-term optimal championship racing strategy). In a similar way, in short-track skating (a sport with qualification procedures that are similar to athletics), it does not seem that athletes generally prioritise conserving their energy resources in the qualification phase provided this achieves an early position within the automatic qualification spots during the race (Konings & Hettinga, 2018a). Competition such as that found in championships, where winning is more important than time recorded, thus encourages a performance climate where ego orientation is more likely to occur (Pensgaard & Roberts, 2002). The results of this study add further support to this view, demonstrating that this trait was likely present in eventual champions and other medallists. It was noticeable in the men's 1500 m that 21 of the 30 semi-finals were won by either the eventual gold or silver medallists; by contrast, bronze medallists only won two semi-finals (and one heat) and could indicate that they were less driven to win qualifying rounds as those finishing ahead of them. An ego orientation within a championship setting might therefore have been beneficial to the champions in achieving success, as athletes might have found winning in the earlier rounds improved their confidence before the final. In addition, it could have intimidated their rivals by displaying how easily they could win, and/or allowed the athletes to avoid the stress of risking missing an automatic qualification position.

Of the 57 gold medallists, only nine recorded a PB (and nine their SB) in the final and thus showed that two-thirds of global champions were able to win despite not achieving even their best time that year. In the most extreme example, the 2016 men's 1500 m Olympic Champion, Matthew Centrowitz, won in a time that was more than 10 s slower

than either his heat or semi-final, and the slowest for an Olympic final since 1932. This might indicate that the mastery goal of achieving one's best time was not as important as ego oriented goals (i.e. winning), but also that championship racing could incorporate task oriented goals such as tactical skills and optimal decision-making. With regard to sex-based differences, the number of gold medallists in the women's 800 m who won both their heat and semi-final (N = 13) corresponded with both men's events; the 800 m women also had similar patterns of finishing times to the 800 m men across the three rounds of competition. Within these events, there was no evidence that women differed in their racing approach from men, or that there were any sex-based differences in how athletes recovered (or not) from previous rounds. By contrast, the women's 1500 m differed from the other events in that fewer than half of the champions had won their heat and semi-final. Although this could suggest a difference in racing approach by athletes in this event, evaluating the progress of the women's 1500 m finalists is quite problematic as this event included 11 of the 16 athletes who were subsequently disqualified (including two athletes who crossed the line first and two who finished second). Although most of these were for doping violations, one was for tripping the leader and race favourite (who had won both her heat and semi-final), and although the results are updated, and medals reassigned, their cheating disrupted the natural competitive state of the race and most who were eventually disqualified prevented other athletes from qualifying from the early rounds. Additionally, one 1500 m woman, who had won her heat and semi-final, later admitted to sabotaging her own performance in the final by falling deliberately when she realised she was not going to win (Hegarty, 2012). Ego orientated behaviours can be beneficial, but an overemphasis on winning, which could include doping (Morente-Sánchez & Zabala, 2013) and cheating by deliberately impeding other athletes (Duda & White, 1992), suggests that the will to win potentially leads to some negative actions.

In middle distance events, the normal format is to hold the event within a four-day section of the championships, so that the heats are held on the first day, the semi-finals on the second, a rest day on the third, and the final on the fourth. By contrast, competitors in other sports (and shorter athletics events) often have multiple races on the same day, with consequent effects on later performances. For example, in short track skating, it was found that high-intensity race efforts earlier that day affected performance of elite-standard skaters in subsequent races, whereas the effect of high-intensity race efforts from the previous day seemed to be only marginal (Konings & Hettinga, 2018b). The longer gap between 800 m and 1500 m in athletics therefore might provide enough rest time between rounds for most competitors to recover sufficiently. Having better aerobic physiology is important in winning any one-off distance race (Gastin, 2001), but those more aerobically fit might also recover better from the heats and semi-finals, which could explain why in the middle distances, medallists improve, but non-medallists are slower in the final than in previous rounds, especially if those rounds were at their all-out pace (Tomlin & Wenger, 2001). Of course, better athletes might also have been able to hold back more during these earlier rounds, but not so much as to miss out on an automatic qualification position or, in the case of most eventual champions, finish first. It therefore appears that one important aspect of winning a major championship medal is the ability to recover from whatever exertion was required to reach the final in the first place.

There was no noticeable sex-based difference in how athletes undertook their long-term strategies across the three rounds (differences in ability within sexes were more important), and so the differences in single-bout marathon running between men and women (Deaner et al., 2015; Hanley, 2016) were not replicated. A reduction in the number of qualification rounds might help more athletes to perform closer to their best in the final, or even to attempt the 800/1500 m double. Given the high proportion of 1500 m first round competitors who qualify for the semi-finals (as high as 24 out of 28 men, and 24 out of 30 women, in 2003), reducing the number of rounds in this event should certainly be considered. In effect, this would mean holding heats before the final only, as occurred in the women's event in 1999, 2005 and 2008. It is clear from the results of this study that the very best athletes in the world qualify in the top positions anyway (as highlighted for the finalists in Table 3, more than 90% of finalists across the four events progressed to the semi-finals as automatic qualifiers), and no reduction in the number of entrants would be necessary. The IAAF is already considering a reduction in qualification rounds (Phillips, 2017) and, although this is realistic in the 1500 m, there is less rationale to remove any from the 800 m. The more competitive nature of the 800 m in terms of qualifying for the semi-finals (only 45% of men and 53% of women qualify from the heats) and the final (usually the top two in each semi-final are automatic qualifiers only) means that the stakes are very high in these earlier rounds and create a racing, rather than a pacing, situation. This creates a performance climate in which eventual champions can prosper.

Conclusions

This study investigated the qualification patterns of finalists in the men's and women's middle distance events at global championships. Most eventual champions won their heat and semi-final, with many other medallists achieving the same feat, even though there was no direct benefit with regard to finishing higher than other automatic qualification positions. This suggests predominantly ego oriented behaviour amongst the world's best athletes that is partly created by the performance climate of a major competition. Even so, the eventual medallists used a long-term championship strategy where many ran below their best in qualification and sped up considerably in the final; by contrast, the lowest placed athletes tended to be slower in the final than the semi-finals. There were few sex-based differences found, and coaches of both men and women should note that racing to win an Olympic or World Championship event requires preparation of short-term and long-term strategies, as well as the tactical and

psychological practice that pre-championship racing can provide.

Disclosure statement

No potential conflict of interest was reported by the authors.

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