The Long Sprint - Reclassifying the 800m

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The 800-meter race is one of the most challenging and exciting events to race and coach in track. Tactically, there is no margin for error and it demands that athletes possess a combination of strength, speed, and endurance. The running community generally regards the 800m, along with the mile, as track's mid-distance events. This perspective influences both the approach to training and racing as well as how talent is funneled for long term development. Recent research on metabolic distribution and pacing strategies challenges this classification. The 800m is an extended sprint similar to the 400m, necessitating a revision of racing and training recommendations.

ENERGY SYSTEM DISTRIBUTION & RACE PROFILES

Scientific research can provide coaches with energetic profiles of running events to establish training intensities, racing tactics, and optimal plans to help athletes reach peak performance. Both aerobic and anaerobic processes contribute significantly to the metabolic demands of long sprint and middle distance events. The Creatine Phosphate (CP) system is able to provide immediate energy without the breakdown of fuels so it is the primary system operating in the very beginning of the race and is able to sustain relatively high intense efforts for roughly 5-20 seconds. For the remainder of the race, the anaerobic glycolytic system supports higher intensity efforts for shorter durations and the aerobic system supports lower intensity efforts for longer durations. The race profile (relative interaction of the energy systems) would therefore be dependent upon the intensity, duration, and type of exercise being performed (8, 12).

Many current coaching practices have been influenced by earlier misrepresentations of the anaerobic energy contribution to sprint and middle distance running events (8, 33). Figure 1 below illustrates several profiles based upon these early energy system models. Utilizing this model, it would seem logical for coaches to perceive the 800m and 1500 as sharing a similar profile. Their more even distributions appear distinct from events of shorter and longer durations lending to their designation as track's "mid-distance" events. These profiles were based on a conceptual model that utilized measures of oxygen debt to quantify anaerobic energy release. This method presented the energy systems as working in a sequential fashion and overrepresented the value of anaerobic energy since it assumed a slow aerobic response rate (8, 20). (See Figure 1)

Medbo, Tabata, et al, helped provide a newer system of assessing anaerobic capacity through the Maximal Accumulated 02 Deficit Model (AOD or MAOD) (14, 15). This model showed that aerobic and anaerobic energy releases were important throughout the entire effort, and although both increased with duration, the relative importance of the anaerobic system decreased (14). They concluded that aerobic energy accounted for 40% of the energy release as early as 30 seconds and an equal contribution was found at 60 seconds during the high intensity exercise (14). This contrasted with the earlier research that set the crossover threshold at or after two minutes (14). In addition to providing a new measure of anaerobic capacity, this challenged the existing energetic profiles and demonstrated that energy systems were not utilized in a sequential manner (14, 15).

Additional studies supported the findings of Medbo, et al, and built upon the model to develop a seemingly more accurate energetic profile of running events (5, 7, 8, 21). Figure 2 below illustrates the newer energetic profile of these race distances developed by Spencer and Gastin. In their study, Spencer and Gastin had athletes simulate various pacing strategies, based upon their own racing experiences, to provide a more real world testing scenario (20). While they supported the new AOD model findings they concluded that in treadmill "simulated" race conditions, the crossover occurred even earlier, somewhere between 15 and 30 seconds (20). (See Figure 2)

As additional research has demonstrated, the crossover varies between individuals based on training status and distribution values vary based on the specific testing methods utilized by researchers (fixed pace, treadmill, cycling, rowing, etc.). For example, Thomas, et al, questioned Spencer and Gastin's use of fixed paced treadmill testing since events like the 800 are rarely run at a fixed pace (21). They concluded when utilizing a different test scenario that, contrary to Spencer and Gastin, middle distance runners did actually reach and exceeded V02 max during an 800m race (21).

Figure 1: Early Profile of Relative Anaerobic/Aerobic Energy Distribution in selected running events (23).

Event	Energy Distribution	
	Anaerobic	Aerobic
400	81.5%	18.5%
800	65%	35%
1500	47.5%	52.5%
5000	20%	80%

Figure 2: Energetic Profile based upon Spencer & Gastin AOD model (8, 20, 23).

Event	Energy Distribution	
	Anaerobic	Aerobi
400	57%	43%
800	34%	66%
1500	16%	84%
5000	12%	88%

In surveying various studies from 1990-2001, Duffield, Dawson, and Goodman found that, despite the AOD being a more accurate method for analyzing anaerobic capacity, a wide range of values has been reported by researchers (6). In their study of actual racing conditions, they found that the crossover point occurred at 40-55 seconds due to higher velocities earlier in the race, and the general model of distribution percentages established by Gastin & Spencer was accurate (6). Figure 3 illustrates their findings, which highlights that even though there is a greater anaerobic dominance in the 400m, and aerobic dominance in the 800m, they are more similar in their relative profiles than previously understood by scientists and coaches (6). While men and women do exhibit slightly different results due to higher velocities and shorter durations of their respective race performances, the relative pattern remains consistent (6). (See Figure 3)

This new research and more accurate profile illustrates that the previous assumption about the limited role of the aerobic system in sprint and middle distance races (200m-800m) is not supported by modern research. In addition, energy systems do not work in an exclusively sequential fashion. Instead, coaches should perceive the aerobic and anaerobic energy systems as working throughout the whole race in an overlapping fashion with their relative roles shifting depending upon the intensity and duration of the race. The most important priority for coaches in establishing an annual training plan should be ensuring a balanced approach that does not overemphasize one specific zone.

These newer findings also illustrate that the current classification system of race events as sprint (100m to 400m), mid-distance (800m to 1600m/3k), and distance (3k/5k to Marathon) is outdated. Ultimately, when expressed in relative terms, the evidence of studies, utilizing AOD in actual race scenarios, show that the 800m race is not truly a middle-distance event; rather it is an extended sprint. In many ways, the biggest change from the research is found in the recognition of the significant role of aerobic energy release in the 400m to the degree that it is much more closely related to the 800m than previously accepted within the coaching community (6). Furthermore, when analyzing the newer distribution model it shows that the 1500m should be grouped with the 3k and 5k since they have almost identical energy releases (2, 20, 23).

While individual training backgrounds and racing tactics always factor into the actual racing effort, the 800m necessitates that athletes fully maximize both aerobic and anaerobic development in their training (4, 13). The effort achieved during the 800m is a near maximum use of anaerobic stores, but there also needs to be a significant aerobic element to sustain the pace (6). While athletes from a wide range of profiles (2, 3) can have success at the 800m, if coaches don't factor in this unique relative energy distribution they will not help athletes maximize their potential or may incorrectly funnel athletes into an event not suited for their individual profiles. In addition, if the 800m continues to be categorized by coaches and publications as a mid-distance event separated from the 400m, training programs will fail to incorporate the proper anaerobic training and optimal pacing strategies necessary for success over that distance (6, 13).

One of the most important under-standings from this newer research is recognizing the critical role of establishing optimal pacing strategies for running events. For the 800m, it has been demonstrated that a fast start is essential to success in the race since the relative use of anaerobic and aerobic energy makes the event a decelerated effort (6, 18). Similar to the 400m, as long as the starting pace of the 800m does not exceed critical velocity that produces excessive metabolic waste, the faster pace maximizes the energetic profile of the event (7, 18, 21). As Timothy Noakes has demonstrated in the Central Governor Model (CGM) of fatigue, it is the physiology of pacing that is the core issue for exercise performance (16, 17). Pacing strategy prevents physiological failure so various systems provide feedback to the brain to gauge a pacing strategy based upon the duration of the exercise (16, 17).

Figure 3: Energetic Profile for Men/Women in 400 and 800m racing events. (6)

Event	Anaerobic(%)-M/W	Aerobic(%)-M/W
400	59/55	41/45
800	40/30	60/70

Figure 4: Average 200m split, approximate first 200m split and approximate 1st to 2nd lap deceleration during the 2012 Men's Olympic 800m final.

Athlete	Average 200m split	1st 200m split	1st-2nd lap deceleration
Rudisha	25.23	23.18	2.75
Amos	25.36	23.66	2.58
Kitum	25.63	23.85	2.77
Solomon	25.71	23.52	3.34
Symmonds	25.74	24.59	2.41
Amman	25.8	23.52	4.53
Kaki	25.83	23.34	4.7
Osagie	25.94	24.18	3.7

Billet, et al, identified that the best 800m runners were those who demonstrated the highest anaerobic capacity at the end of the race (1). Whereas the best 1500m runners were those who possessed the highest time limits at anaerobic power in the first two-thirds of the race, based upon lower start velocity (1). Therefore, since the 800 is more of a sprinting effort, it is important that athletes maintain as high of velocity as possible before exhaustion and 1500m runners not start too fast to extend the time limit of anaerobic power (1). Training models and racing strategies that perceive the 800m and 1500/1600m as similar will undermine the optimal adaptation of athletes to the unique pacing demands of the 800m.

Optimal Pacing for 800m Race

Recent studies on pacing strategies and world record (WR) progressions support this classification of the 800m as an extended sprint. Although the 800m and 1500m races can be complementary, the optimal pacing strategy of the 800m is more similar to the 400m since both exhibit a declaration effect (9, 19). Unfortunately, since many coaches and athletes still perceive the 800m as a distance event, they strive for an even or negative split pacing strategy utilized in events ranging from the 1500m to the marathon. In addition, training programs that overemphasize the aerobic system at the expense of anaerobic development, unknowingly prepare 800m athletes to only be able to run an even or negative split pace. Those athletes may run a relatively fast 800m, but since they have been trained to race with a suboptimal strategy, this approach undermines their true performance potential. The unique energetic profile of the 800m requires a positive split pacing strategy for maximum performance.

Several researchers have compiled and analyzed elite performance and world record (WR) data that clearly demonstrates the importance of viewing the 800m race as a decelerated effort. Ever since the first 800m race was run below 1:50 in 1932, only two out of the 22 WR performances were run as negative splits (10). In their analysis of 800m WR performances from 1912 to 1997, Tucker and Noakes found that the second lap of the 800m was slower (approximately two seconds) than the first (22). In an article published for the BMC, Kevin Prendergast noted that the positive split differential for elite 800m performances was approximately 1.8 seconds and that speed roughly dropped two percent for each 200m segment (18). Using a mathematical model to quantify the deceleration, he argued that the optimum pace per 200m segment of the race would be 104.5%, 99.25%, 98.5%, 97.73% of the average goal pace (18). James Reardon's mathematical model of entropy accumulation further substantiates the decelerated nature to both the 400 and 800m (19).

The fastest runners in the event have demonstrated this trend. Wilson Kipketer's fastest 800m was run with a 5% positive differential (1:41.11-49.3/51.8), Joaquim Cruz a 4% differential (1:41.77-49.7 & 52.0), and Seb Coe also ran a 4% differential (1:41.73-49.7/52) (11). David Rudisha's sub 1:41 WR 200m splits in 2012 exhibited a 10% velocity decrement (19). An examination of the splits of all athletes running against Rudisha in the 2012 Olympic 800m final highlights the deceleration pattern found during the last 600m of the race and provides insight into optimal pacing strategies. This particular race is noteworthy since it represents the fastest and deepest 800m race ever run, with all finalists earning personal bests and eight sub 1:44 performances. In fact, the eighth place time would have taken the gold medal at the previous three Olympics. (See Figure 4)

While race tactics always factor into race performance this specific race serves as the best example of an optimal 800m racing effort. As shown in figure four above, all athletes ran a faster first 200m than their average 200m pace for the whole race, and all had a second lap significantly slower than their first lap. The decisive factor separating the medalists from non-medalists was who had the lowest degree of deceleration, as long as the initial 200m acceleration was maximal, relative to their overall average pace.

In the first 200 meters of the race, the athlete must accelerate quickly to obtain a tolerable pace that is as close to their maximum speed as possible. If the athlete is unable to do this, they will not achieve the relative pace necessary to offset the deceleration effect found later in the race. As the effort progresses through the remaining 200m segments, the athlete must sustain a pace close to the average desired pace, while reducing the degree of deceleration. Although it is possible for athletes to run a relatively fast 800m race using an even paced or negative split strategy, regardless of their individual profile, the effort will be suboptimal, and they will not reach their maximum potential for that distance.

The energetic profile and deceleration effect of racing an optimal 800m necessitates that it be classified as an extended sprint. Although the 800m and mile/1500m can be complementary events for athletes, it is more functional to consider the 800m as similar to the 400m and the mile as similar to the 3000/5000m races. Interestingly, given the energetic and pacing correlation between the 400m and 800m events, it is surprising that U.S.A. Track and Field has been underrepresented on the international level in the 800m. Even a cursory glance of the all-time performance lists for the 400m and 800m on the IAAF website shows how the American domination of the 400m has never correlated to success in the 800m. Given the amount of developmental athletes (high school and collegiate) in the United States who compete at a high level in both the 400 and 800, this demonstrates a fundamental flaw in the training approach and system of funneling athletes into events. In order to fully develop the potential of 800m athletes it is necessary to begin classifying it as an extended sprint and ensuring that training programs reflect the unique energetic and pacing demands of the event.

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