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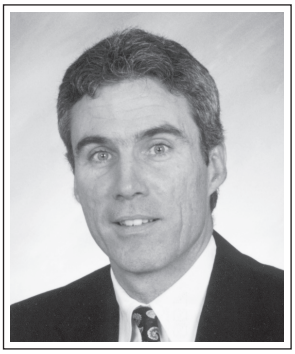
FROM THE EDITOR

RUSS EBBETS

THE BUNION DERBY



The general public has long been fascinated by feats of human performance. If you think back to the days of P.T. Barnum and his circus, the side shows were a stunning collection of strong men and women along with human oddities that kept the "suckers" amazed and returning year after year.

In Bill Pearl's book, *Getting Stronger* (Shelter Publications) he chronicles a number of early strong men whose demonstrations defied imagination. These guys lifted huge dumbbells, bent steel bars and ripped decks of playing cards in half signifying much more than just the simple vitality of a firm handshake.

It seems difficult to imagine in our "all news, all the time" times that anyone would pay to watch a dance marathon or the 17,000 laps of a 6-day bicycle race, but in the 1930's the bicycle race was a financial mainstay for promoters and routinely sold out Madison Square Garden.

Walking feats date back to the early 1800's when Robert Barclay Allardice walked one mile every hour for 1000 consecutive hours, covering 1000 miles. It took him 42 days to complete this feat. No doubt he suffered from "sleeptus interruptus."

For the last 100 years a more popular endurance endeavor has been to walk 100 miles in a 24-hour period. This feat earns one the title of Centurion. To date fewer than 100 Americans have accomplished this feat, compared to over 1000 UK walkers. For those challenged by the math these walkers averaged 4.16 mph for 24 hours. Just try walking 4 mph on a treadmill.

Running seemed to lag behind all this hoopla. Even the venerable Boston Marathon drew small fields with only 18 runners in the inaugural event. It took 30 years before the race finally cracked 200 starters. The low participation rate may have been due to the dire predictions of medical authorities that warned of cardiovascular collapse. Clarence DeMar won the race seven times and had a different opinion. He's reported to have eulogized one of his marathon buddies, who died at 110 years old, "The experts said it was running that killed him."

The attitudes about running all began to change with an idea from Charles C. Pyle.

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EDITORIAL COLUMN

Continued from page 7420

Sports promotor C.C. Pyle (a.k.a. Cash & Carry) got the idea for a 3400 mile run across America to promote the completion of the famous Route 66, America's first transcontinental highway set to open in 1928. Professional runners from 24 nations signed up to participate. The first place prize was $25,000. That prize was figured to be the equivalent of 20 years salary for the average American working man. The race began with 199 runners.

Despite the glorious anticipated payday, hills, heat and the grind of 60-mile days thinned the ranks by 70 runners after the first week. Dubbed "The Bunion Derby" by the press and championed by Pyle's incessant promotion, the Bunion Derby soon captured the imagination of the country.

With competitors from Europe, Africa and North America everyone had someone to cheer for. The race was set up like the Tour de France with daily destinations and cumulative segmental timing. Each day was a new day with rabbits and hares and the endless miles. National interest continued to grow as the ultramarathoners crept their way across the US.

Famed distance runner Arthur Newton from South Africa was one of the early favorites and early casualties. Soon three runners began to separate from the field, Englishman Peter Gavuzzi, New Jersey's John Salo and Oklahoma's 20-year-old Andy Payne.

In Ohio Gavuzzi dropped out due to dental problems and the battle for the top two spots was set. Early on Payne ran with a bout of tonsillitis but was able to remain competitive. It was in his native Oklahoma where he inched to the lead. From that point on he was never bested and labored on to a 15-hour victory by the race's end in New York City.

The final leg of the 84-day race was a grueling 20-mile run around the board track at Madison Square Garden. At this point only 55 runners remained. Payne negotiated the 200+ laps in front of an enthusiastic crowd to win the well earned grand prize.

The race was contested a few times more and went through several reincarnations but it never again captured the national attention of the inaugural race. Payne raced a few more times and went on to graduate from law school. He invested his prize money in Oklahoma land that eventually produced oil and gas. Salo won the 1929 Trans-America race only to die an untimely death two years later after being struck in the head by a wild throw at a baseball game.

The running boom of the 1980's was some 50 years away, but these early pioneers laid the roadwork that legitimized long distance running and served as living examples of the limits of human endurance. USATF National Chairperson of the Mountain Ultra Trail Council Nancy Hobbs has more to say on the subject in her interview in this issue.

Finally, it bears mention of the passing of Coach Ed Bowes of Bishop Loughlin High School in Brooklyn. For almost 50 years any runner from the New York metropolitan area (and well beyond) was touched by Ed's dedication to the sport. He founded and served as race director for the Manhattan Cross Country Invitational held each fall at Van Cortlandt Park. The Manhattan Invite is touted as the largest high school XC meet in America with over 10,000 yearly participants.

The Bishop Loughlin Games are a yearly fixture in the metropolitan New York indoor scene. Ed also had some success as a coach. It is a lifetime achievement for a high school coach to have a distance medley relay team compete in the Championship of America race at the Penn Relays. Ed has the singular distinction of having Loughlin teams win the race three times. Ed was a mentor to many and a friend to all. May you rest in peace.

"IDEAL" TRAINING FOR THE SPRINT HURDLER

A perspective on how the coach can manipulate and mimic the training environment to create "ideal" training" for the sprint hurdler.

BY MIKE THORSON, UNIVERSITY OF MARY HURDLE COACH (FORMER DIRECTOR OF TRACK & FIELD/CROSS COUNTRY AT THE UNIVERSITY OF MARY, BISMARCK, NORTH DAKOTA)

Our top level sprint/hurdle coaches are frequently asked an assortment of difficult and challenging questions concerning training in today's track & field world. What is the best training? What are the best drills that should be used? What are some of the "secrets" that enable top-level sprinters and hurdlers to be successful…to be elite?

Everyone wants the "magic" formula. Everyone is looking for that little, extra edge. Unfortunately, there isn't any such thing. Most coaches will tell you there are no real secrets or shortcuts to success…no quick fixes. The **basics** are the foundation of their coaching and they coach the **fundamentals** each and every day. The leading, elite coaches employ sound, science-based training developed from years of research and proven results.

A lot of young coaches (and some not so young) may be surprised when they learn that the best or "ideal" training for sprinters and hurdlers is **competition—actual meet competition!** Success in the sprint hurdles is largely determined by the ability of the hurdler to generate very large amounts of power and strength at exactly the right time! *There is no better way of training than in competition. None.*

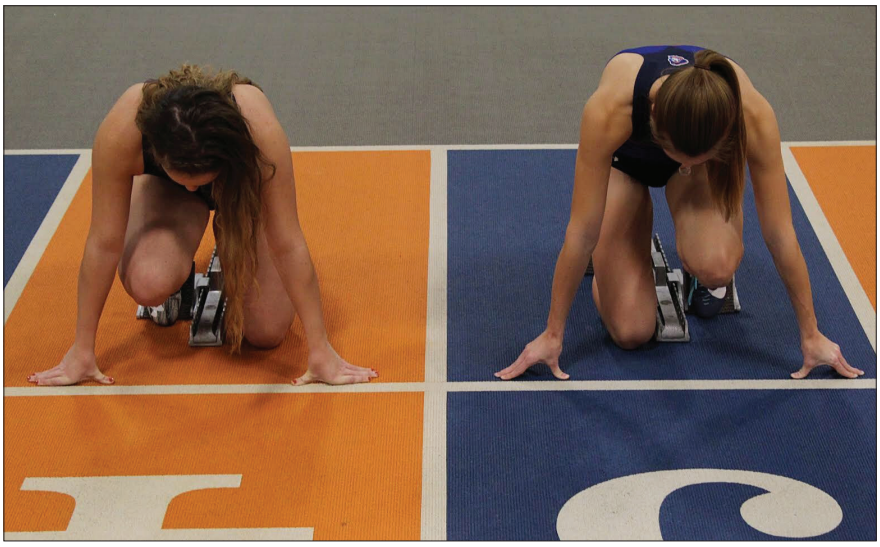
The greatest speed training environment occurs in actual **races**, according to Ralph Mann and Amber Murphy in a book entitled, *The Mechanics of Sprinting and Hurdling.* Competing often and using competitions as your optimal training ground is a recipe for success, as many high school

and collegiate athletes have discovered. Usually discovered, we might add, by accident. Many high school athletes compete in two to three competitions a week and do multiple events. It is the same with many collegiate sprinters and hurdlers. They compete every weekend in a lengthy indoor and outdoor season, sometimes competing in back-to-back days of preliminary and final rounds. It makes for a lot of competitions and "optimal" training as a result.

That likely explains why some of America's top professional sprinters and hurdlers see their performances diminish after their collegiate careers come to an end. They simply do not obtain the consistent, optimal training that frequent competition affords them. This article will examine the challenges that coaches of sprint hurdlers have in replicating the training for their athletes that competition provides.

THE GOAL IS TO CREATE IN A TRAINING ENVIRONMENT WHAT ACTUALLY TAKES PLACE IN A COMPETITION!

It is certainly no easy task. To say that it is problematic is an understatement. It is very clear, however, that many coaches do not have their hurdlers doing the correct training to meet the demands of the women's 100-meter and the men's 110-meter hurdle events. The coaches are not meeting the requirements of stride rate, stride length and tempo (rhythm) that the hurdler will face in competition. Coaches are often misguided in what really needs to be trained and this will typically lead to long-term problems and errors.



Consistently training incorrectly really compounds the problems. The old saying about practice *making permanent and not perfect* certainly rings true in this case. If it is true that it takes 25-30,000 repetitions to undo an incorrect motor pattern, as Arizona Cardinals strength coach Buddy Morris believes, and suggests this becomes very troubling indeed.

Another aspect that is very concerning is the emphasis that many coaches place on **drills**. Former Illinois and Florida State Coach Gary Winckler, a Hall of Fame sprint/hurdle coach, presented a clinic at the University of Mary in Bismarck, North Dakota in 1997. After he talked very little about drill work in two days of speaking, the author questioned him about drills at the conclusion of the seminar. Winckler responded, chuckling, "We don't do a lot of drills. If you want to be a good hurdler, hurdle. And hurdle correctly," he added.

We are certainly not advocating that hurdle coaches shouldn't do drills. Quite the contrary. One of our favorite slogans that we frequently employ with our athletes is: "You are only as fast as your mechanics and technique will allow." Great technique maximizes speed and minimizes a lot of wasted effort that can lead to late-race fatigue. You do need drills to teach the mechanics, and drills are a method of teaching this, especially with the men's hurdles. Many authorities would agree the men's 110-meter hurdles are the most challenging technical event on the track. But coaches are often disappointed that their athletes can't replicate the skills and mechanics in competition that they master in the slower drill work. And there is really no question; mechanical flaws will be amplified at the higher competition speeds.

Another challenge for the hurdle coach will be balancing every component that needs to be trained without overloading and stressing the athlete. The noted author Malcolm Gladwell sums it up best: "Practice isn't the thing you do once you're good. It's the thing that makes you good." You obviously have to practice and train. But coaches would be wise to keep in mind that it is a very delicate balancing act. Once an athlete is **overtrained**, there is no going back and the season is basically over.

When you consider that it can take up to 500 hours to refine a skill and establish a proper motor pattern, it is quite easy to see that a big part of the job description of a hurdle coach is time management. Gladwell, in a book entitled "Outliers," claims it takes 10,000 hours and approximately 10 years to achieve top-level expertise. Another critical factor: athletes are capable of handling only approximately **three minutes** of high-stress activity/intensity per workout session, according to biomechanist Ralph Mann. This is certainly a challenge, but the goal of training the hurdler to replicate, simulate and mimic the competition motor patterns/rhythm is certainly obtainable and is currently being done by many sprint hurdle mentors.

So…how does the coach go about this task? One of the first considerations that a coach has to be aware of is the fact that the stride rate for a hurdler is quite different than for a sprinter. The standard spacing in the hurdle races dictates this. The spacing simply doesn't allow for the hurdler to take a normal sprint stride. The sprint hurdle coach is constantly faced with the question of how do you adjust sprinting to sprinting between the hurdles? A hurdler can generate only about 75% of his horizontal sprint velocity in the hurdle race, again per Ralph Mann.

Mann goes on to say that only approximately 40% of the steps in a hurdle race can contribute to horizontal velocity. He also says 20% lose velocity and 40% are neutral. With that being said, it is very clear that you can't just train **speed** and expect success in the 100 and 110-meter hurdle races.

"**Train speed,**" was the common answer the author would receive when, as a young coach, he would ask the elite hurdle coaches what was the most important component to train. No one ever really elaborated as to "what kind of speed."

ONE OF THE FIRST CONSIDERATIONS THAT A COACH HAS TO BE AWARE OF IS THE FACT THAT THE STRIDE RATE FOR A HURDLER IS QUITE DIFFERENT THAN FOR A SPRINTER.

What we really need to say when we talk about speed in the sprint hurdles is hurdle speed. Or more accurately, hurdle rhythm, as the late Brent McFarlane always talked about when he spoke about training your short hurdlers. It is about establishing and "etching in" the correct motor patterns, the correct hurdle rhythm that replicates what the hurdler will actually employ in competition. Not that speed development isn't critically important. It is essential…crucial! The sprint hurdles are speed events and you obviously want your hurdlers to be as fast as possible. Nearly all coaches will agree that improving maximum speed is the best way to improve your hurdle performance. Improving your maximum speed will improve your acceleration and the sprint hurdles are basically a series of accelerations. So there is no question that a large percentage of your training time should be devoted to speed development and speed enhancement.

Another factor that coaches should remember: neuro-muscular motor patterns don't work like the old Etch-A-Sketch toys. You can't just the flip the Etch-A-Sketch over and start again. It doesn't work that way with motor patterns. Coaches must be cautious and not create movement stereotypes where the

motor pattern or muscle memory becomes programmed and "fixed" and you establish **barriers** to speed development and hurdle rhythms.

Authorities acknowledge that there is a 5-10% drop-off in training compared to competition. Taking all this into account, how does the sprint hurdle coach manipulate the environment to obtain competition level speeds in training? We are doing a combination of things at the University at Mary to accomplish this goal:

1. **Reducing Hurdle Heights**: Most of our women's hurdling is done using 30" hurdles or shorter, compared to the normal height of 33". Men hurdle at 39" and even 36". Not that the men don't hurdle at the normal 42" height on occasion, but it is infrequent. Miniature hurdles, scissor hurdles, speed hurdles and even cones can be employed to accomplish the lower training heights. The author removed the hurdle tops and placed pre-wrap at the desired height on the hurdle as a high school coach on a very limited budget years ago.

2. **Discount Hurdle Spacing**: Our women never hurdle at the standard spacing of 8.5 meters. Our training distance is typically 8.0 meters. The men normally train at 29 feet or 8.84 meters (one foot shorter than normal race spacing). Unlike some coaches, we rarely alter the first hurdle distances (unless attempting to correct a serious first hurdle flaw), preferring not to *mess* with the first hurdle stride pattern and the resulting mental issues. The discounted spacing measurements can and will vary depending on the athlete and individual coaches preference. The spacing will also change as the season progresses and the hurdler becomes faster and stronger.

TEMPO HURDLES ARE DONE AS A PRELIMINARY ACTIVITY LEADING UP TO ACTUAL HURDLING FROM BLOCKS.

3. **Place Hurdlers in Competitive Situations**: Coaches, especially high school coaches, may be surprised to hear that we very seldom train our hurdlers in solo situations. A very large percentage of our training is done with our hurdlers competing head to head with teammates. Just having a teammate alongside "gets the competitive juices flowing," leading to increased speeds and hurdle rhythm and accomplishing our training goal. Another exercise that accomplishes much the same is where a hurdler races a sprinter, who is handicapped at the start and starts from a 3 or 4-point stance opposed to blocks. This obviously only works for short distances, but aids in setting up the opening tempo speeds for the hurdler.

4. **7.5 Craig Poole Drill**: Competitive hurdling from blocks with the hurdles placed at 7.5 meters for the women and 28 feet (8.53m) for the men. This is a lead-in "drill" with hurdling immediately following at the training distances of 8.0 meters for women and 29 feet (8.84m) for men. This exercise, modified for our use, was taken from Craig Poole, the Hall of Fame coach who was a long-time mentor at BYU and who is now at San Diego State.

5. **Tempo Hurdles**: Tempo hurdles are done as a preliminary activity leading up to actual hurdling from blocks. Spacing is 7.5-7.7 meters for women and 28 feet (8.53m) for men and the hurdlers start from a 3 or 4-point stance over sets of any desired number of hurdles (the number of reps and sets should be low due to the fatigue factor and our goal of not deviating from the motor pattern that we are attempting to establish).

6. **Increased Hurdle Spacing**: Although we seldom employ this, many coaches successfully increase the spacing between hurdles so that the distances are further than competition marks to increase stride rate and improve hurdle rhythm. They often use a 5- or 7-step stride between hurdles. The author typically for spacing uses 11-12.0m for women and 12-13.5m for men for the 5-stride drill, depending on the state and caliber of the athlete. Ralph Lindeman, a very well-known hurdle authority from the Air Force Academy, uses 13m for men and 11.5m for women.

Other helpful considerations:

1. The coach should design the hurdle training sessions and training week days so that the athletes are basically fatigue free and rested prior to the sessions. Coaches can't expect athletes to obtain the proper hurdle rhythms in a fatigued

The following hurdle technique sessions, one indoor and one outdoor, display how the University of Mary trains speed development and replicates the competition rhythms and motor patterns in training:

Monday, January 20 Men's and Women's Hurdles (Indoors)

1. Marauder Sprint-Hurdle Warm-up
2. Cone Hops/Squares
3. Hurdle Hops 4 Hurdles 30' x 2 with ball 3k-W 4K-M
4. Hurdle Hops Lateral 4 Hurdles 24" x 2
5. Backwards Walking Lunge 2 x 10 meters
6. Speed Bounding 2 x 30m
7. Accels with spikes 4 x 40m

1. 1 Step Hurdles 8 Hurdles x 2 30"
2. 2 x 20m Flys Straightaway
3. Tempo Hurdles 2 x 2 x 2 Hurdles Men—1st set-36" 2nd set—39-36 Women—30" both sets
4. Start from 4-point Hurdles at 7.7m for women and 28 feet (8.53m) for men
5. 2 x Sled Pull with hand weights 20m

1. 4 Hurdles From Blocks x 2 W—30" @ 7.5 m M—39"-36" @ 28 feet (8.53m)
2. 1 x 20m From Blocks
3. 6 Hurdles From Blocks x 2 W—30' @ 8.0m M—39" @ 29 feet (8.84m)
4. 3 Hurdles From Blocks W—33"-30" @ 8.0m M—42"-39" @ 29 feet (8.84)

**Record touchdown times for all reps from the blocks

Monday, April 13 Men's and Women's Hurdles (Outdoor) Week of Mt. Sac Relays/Azusa/Long Beach

1. Marauder Sprint Hurdle Warm-up
2. Hurdle Hops 6 30" Hurdles x 2 w/3k ball
3. Crane 2 x 10m
4. Duck Walk w/3k ball Eyes Closed 2 x 10m
5. Accels 4 x 30-40m w/spikes

1. 1 Step Hurdles 9 Hurdles x 3 30"
2. 1 x 20m from 4-point start
3. 1 x 30m Fly (Straightaway)
4. Tempo Hurdles W—3 Hurdles @ 30" x 2 @ 7.7m M—3 Hurdles @ 36" x 2 @ 28 feet (8.53m)
5. 1 x 30m Fly (Straightaway)
6. Tempo Hurdles W—3 Hurdles @30" x 1 @ 7.7m M—3 Hurdles @ 39"-36" x 2 @ 28 feet (8.53m)

1. 3 Hurdles From Blocks x 2 W—30" at 7.5m M—39"-36" @ 28 feet (8.53m)
2. 3 Hurdles From Blocks x 1 W—30" @ 8.0m M—39" @ 29 feet (8.84m)
3. 10 Hurdles From Blocks x 2 W—30" @ 8.0m M—39" @ 29 feet (8.84m) (10-12 minutes recovery between reps)
4. 7 Hurdles From Blocks x 1 W—33"-30" @ 8.0m Men—42"-39" @ 29 feet (8.84m)

**Record touchdown times for all reps from blocks

@@@The goal is to train approximately 3 minutes of high intensity/stress per hurdle training session

state. The same is true of the individual training sessions. Technique and mechanics must be closely monitored by the coach and the session should be curtailed immediately if a breakdown is detected. A helpful tool to pinpoint weaknesses in a race plan and to assist the coach in monitoring the fatigue factor is to use touchdown times and the accompanying touchdown charts. There are numerous charts to be found, but the best can be found in the book entitled, "The Science of Hurdling and Speed" by McFarlane. Stressing the importance of touchdown times, Gary Winkler once told the author that they charted every touchdown time in their practice sessions when he was at the University of Illinois.

2. Athletes can create more power and speed by using a breathing model where the breath is held in the blocks and "blown out" on hurdles 1-3-5-7-9. Elite hurdlers will use a somewhat different pattern, blowing out on hurdles 1-4-7-10. The breathing model is based on the Val Salva Manoeuver, which contends that more power and strength can be produced when holding and blowing out the breath. It is a well- known fact that athletes can only briefly hold the breath (approximately 2.5 seconds) without creating undesirable effects.

3. **Arm mechanics**: Coaches should stress the correct use of the arms, as it is the arms that really control front-side mechanics, balance and ultimately, the athletes' acceleration. Keep in mind that hurdlers never reach maximum velocity in the short hurdle race. The sprint hurdles in a nutshell are essentially ten different acceleration patterns!

CONCLUSION

Oftentimes incorrect training on the part of coaches establishes "permanent" motor patterns that are a limiting factor in the success that a hurdler can obtain. Most authorities and coaches can recognize after viewing the research and studies that the "ideal" or "optimal" training for the 100 and 110-meter hurdler is **competition—meets!** But, the reality is many coaches are not training their hurdlers to meet the demands of the race. It is in many ways a disservice to the athletes.

And it is sad, because as this article has suggested, there are numerous methodologies that exist to train the correct motor patterns. They must be rehearsed over and over! But it can and is being done by many coaches. That is the challenge for the sprint hurdle coach: Design and implement TRAINING that mimics and replicates competition and translates to success for their sprint hurdlers!

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ELITE LEVEL DEVELOPMENT RATES AND AGE-BASED PERFORMANCE PATTERNS FOR THE MEN'S THROWING EVENTS

The title of this article says it all: Babbitt and Saatara have crunched the numbers and show at what age male throwers reach peak performance.

BY DON BABBITT, UNIVERSITY OF GEORGIA, AND MOHAMAD SAATARA, UNIVERSITY OF CALIFORNIA BERKELEY

ABSTRACT

A statistical analysis was performed on data taken from 23 or 24 of the top performers of all-time in the men's throwing events. The purpose was to generate an age-based table of performance norms for the all-time best throwers in each throwing event, and compare and contrast the developmental rates of the four throwing disciplines as they pertain to reaching top performance. Age-based norms were created by calculating the average best mark of the top athletes for each year between18 to 30 years of age. The rate of development as it pertains to biological age was calculated for each throwing discipline by creating a chart which plots the percentage of a given group's maximum performance for that year relative to their best all-time performance. Results suggest that the javelin was the fastest developing event to best performance, while the hammer and discus throws displayed the slowest rates of development.

This statistical study was influenced by the work of Pavel Tilinger, Karel Kovar, and Petra Hlavata in their

TABLE 1

	Shot Put	Javelin	Discus	Hammer
AVERAGE BIRTH YEAR	1969.7	1973.4	1964.7	1968.1
AVERAGE AGE FOR PB	27.3	25.0	29.1	29.2
AVERAGE PERSONAL BEST	22.33m	90.50m	71.39m	83.74m
HIGH PB IN SAMPLE	23.12m	98.48m	74.08m	86.74m
LOW PB IN SAMPLE	21.92m	88.22m	69.91m	82.40m
NUMBER IN SAMPLE	24	23	24	24

Table 2

	ROTATIONAL SHOT PUT	GLIDE SHOT PUT
AVERAGE BIRTH YEAR	1971.7	1962.7
AVERAGE AGE FOR PB	28.0	26.9
AVERAGE PERSONAL BEST	22.00m	22.06m
HIGHEST PB IN SAMPLE	23.12m	23.06m
LOWEST PB IN SAMPLE	21.47m	21.68m
NUMBER IN SAMPLE	24	23

study on the dynamic progress of performances of prominent world-class athletes in selected track and field events from 2005[1]. While the Tilinger, et al study examined data from a variety of running and field events, the scope of this project was focused exclusively on the men's throwing events with the subject groups consisting of 23 or 24 of the all-time performers in each of the four throwing disciplines (shot put, discus, javelin, and hammer). The members of these elite subject groups have shown to be the predominant medal winners at the sport's highest levels (Olympic Games and World Championships). The purpose of the study was to inspect the performance data in a way to give an idea of what to expect when striving for elite performance:

1. Calculate the average age of top performance for each of the four throwing disciplines.

2. Generate an age-based table of performance norms for the all-time best throwers in each throwing event.

3. Compare and contrast the developmental rates of the four throwing disciplines as they pertain to reaching top performance.

OUTLINE OF THE GROUP DATA

Preliminary calculations were made to find the average age for achievement of personal best and average birth year for each throwing group. The overall results showed that the top throwers realized their best marks in their mid- to late twenties. A more detailed examination of Table 1 reveals that the discus and hammer groups were roughly 10% older than the shot put and hammer groups when it came to the average age that the athletes produced their personal bests.

A potential explanation for the age difference in reaching top performance in the discus and hammer versus the shot put and javelin may be that the discus and hammer are more rhythmic events that require many more throws and practice time to perfect the optimal technique for an individual. It should also be noted that the overall delivery paths for the discus and hammer throws are significantly longer than for the shot put and javelin throw. In addition, the contribution of the final delivery phase of both the discus (~55%)[2,3], and hammer (~15%) [4,5,6] to the final release speed is smaller than for the shot put (~82%) [7] and javelin (~75%) [8]. These factors suggest that the throwing movements, overall, are more intricate for the discus and hammer throw, thus necessitating more time and repetition in comparison to the shot put and javelin to achieve top results.

A further stratification of data was also done for the shot put as there are two distinct techniques used to throw the implement. Table 2 highlights these calculations, and as one can see, the figures are fairly equal except for the average birth year of the top throwers. The javelin, as expected, had the youngest group of top performers due to the fact that the new rule javelin changes were implemented in 1986. It is interesting to note there is a nine-year difference between the top practitioners of the rotational technique (1971.7) versus the glide technique (1962.7).

Chart 1

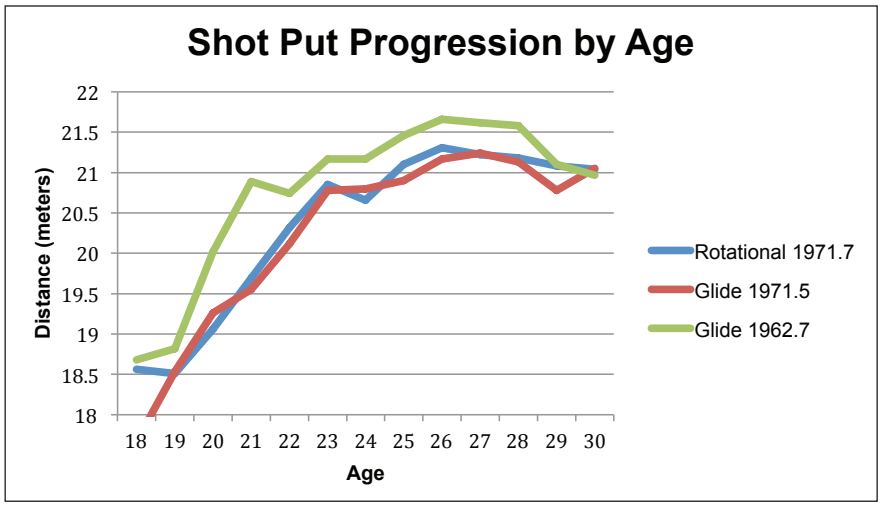
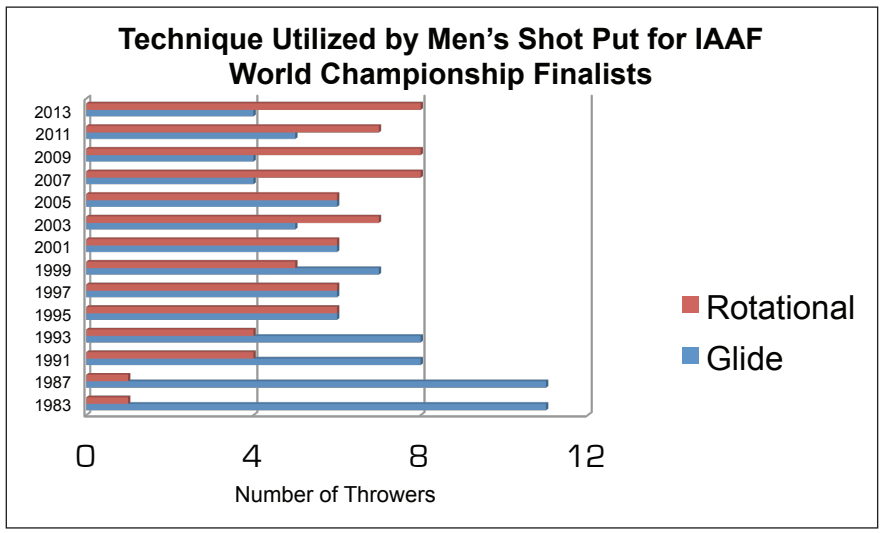


Chart 2



When the glider group's average birth year was adjusted so that it was equivalent to the top rotational throwers, the performance levels adjusted down significantly (Chart 1). This suggests that the very elite gliders were much more prevalent in the past and are not as common in recent years. This idea can be supported by the fact that the finalists in the Olympic Games/World Championships have transformed from an 11/1 glider to rotational ratio in 1983, to between a 2/10 to 4/8 glide to rotational thrower ratio in the more recent major championships (Chart 2).

PERFORMANCE BY AGE

Table 3 shows the average best for each elite throwing group of the four throwing disciplines at a given age. This simple calculation was done averaging the best performances by the members of each group for every age between 18 to 30 years of age. From these numbers, one can have a general idea of what developmental markers a potential medalist would need to reach in a particular event at a given age.

The rate of development as it pertains to biological age was calculated for each throwing discipline by creating a chart which plots the percentage of a given group's maximum performance for that year. Table 4 illustrates an example of how this data was formatted for the javelin throw. Chart 3 shows that the shot put group was found to be the one that reached the highest maximum performance level at the youngest age (26 years of age). The javelin group followed at 27 years of age, and the hammer and discus groups at an average age of 28.

The discus also displayed the slowest rate of development, but also showed the lowest drop off in terms of age-related performance after maximum performance was achieved. The hammer throw also displayed a similar pattern, which supports the notion that these two events take longer to achieve peak performance and can see the prime performance years go well past 30 years of age. Conversely, the javelin throw, which appears to have the fastest rate of development, also has the quickest rate of decline in performance. Further research into the performance levels of these groups between ages 31 to 35 could perhaps shed further light on the long-term rates of decline.

PERFORMANCE BASED ON YEARS TO BEST MARK

A second analysis of performance development was conducted by charting each throwing group's rate of development toward their best performance, with T indicating the year of best performance (Chart 4). This was done for either an 8 or 10-year period leading up to maximum performance. Unlike the Tilinger, et al study, which was able to chart performance going back

to the initiation of full time training, this study was limited to a period no more than ten years prior to the achievement of best performance. For most of the athletes in this study the analysis began around their third or fourth year of full time training. Investigating a longer period of development was also complicated by the fact that many of the throwers born after 1985 used different weight implements at the junior level so it was risky to convert their junior performances (with the javelin, hammer and discus) to those with the senior implements.

The analysis demonstrated the rate of improvement from year to year toward the top results that the athletes would produce. As confirmed by the age group analysis, the javelin showed the steepest rate of improvement toward peak performance. The hammer throw showed the slowest, or most gradual rate of development over the ten years leading up to best performance.

CONCLUSION

There are a variety of observations and trends which can be drawn from this data analysis. These are subjective in nature, and can be used as a rough outline for coaches and athletes to follow when planning and comparing their long-term training with the elite competitors in the throwing events. A more detailed study and analysis will be necessary to generate results of statistical significance.

As a group, the men throwers appeared to reach their peak years of performance in their late 20's. Discus and hammer throwers who participate in the most rotational and rhythmically dependent events had the latest average age to reach their best performance at 29 years of age (Table 1). These throwers also displayed the slowest rate of loss of performance after they reached their peak (Chart 3). Further investigation into erosion of performance rates going during the early to mid-30's would provide for an interesting future study.

It was also evident that a more dynamic event, like the javelin in which elite performance requires a release velocity of up to 30 m/s, had a more rapid rate of development than the other throwing events (Chart 4). Conversely, because of the explosive nature of the event, the longevity of an elite athlete's performance window does not appear to last as long as the other throwing events.

One final trend that was observed was that the rotational shot seems to be solidifying itself as the primary technical model for elite shot putters. This is not to suggest that the glide variation is not a highly successful technique, but that the vast majority of top male throwers in the past 20 years have used the

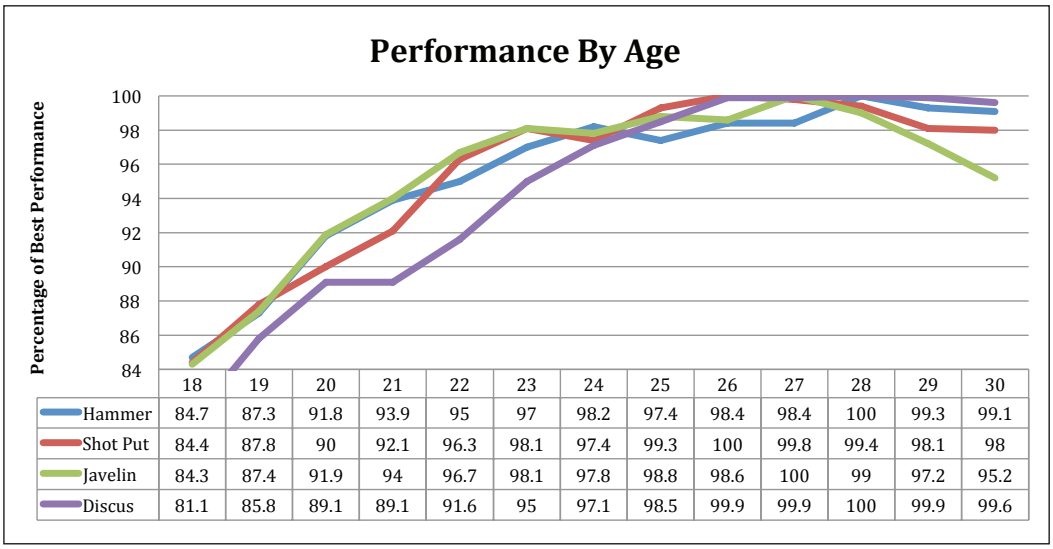
Table 3

Age	Shot Put	Discus	Hammer	Javelin
18	18.30m	55.66m	69.39m	73.94m
19	19.03m	58.92m	71.55m	76.70m
20	19.49m	61.17m	75.27m	80.67m
21	19.95m	61.15m	76.98m	82.44m
22	20.87m	62.91m	77.85m	84.88m
23	21.27m	65.23m	79.51m	86.13m
24	21.09m	66.70m	80.45m	85.81m
25	21.50m	67.61m	79.83m	86.68m
26	21.66m	68.56m	80.68m	86.52m
27	21.61m	68.56m	80.68m	87.71m
28	21.52m	68.63m	81.93m	86.90m
29	21.25m	68.58m	81.34m	85.25m
30	21.20m	68.37m	81.20m	83.58m

Table 4

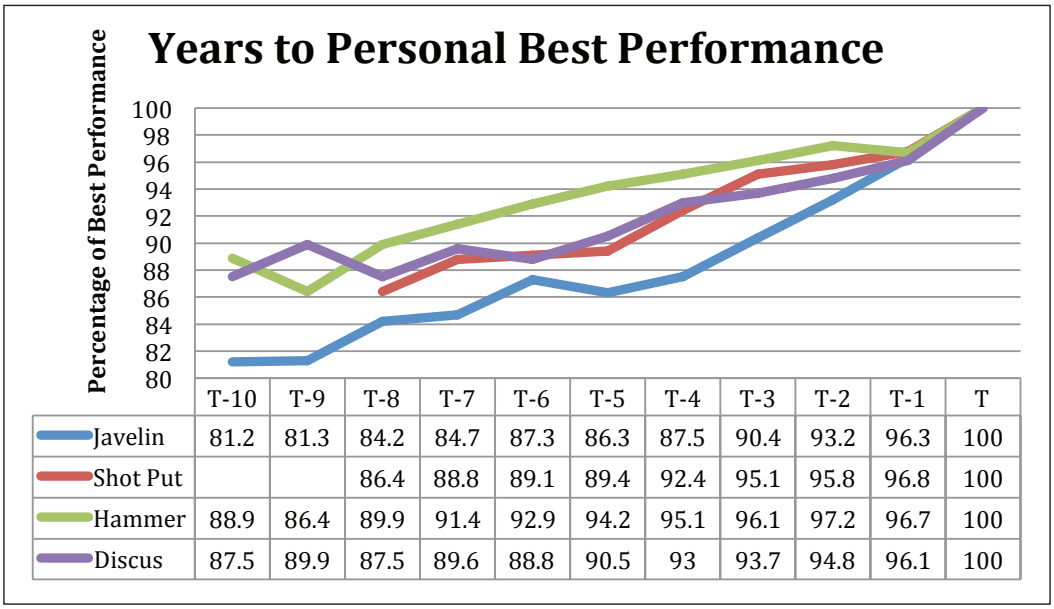
Javelin		
Age	Performance	% of Max. Performance
18	73.94m	84.3%
19	76.70m	87.4%
20	80.67m	91.9%
21	82.44m	94.0%
22	84.88m	96.7%
23	86.13m	98.1%
24	85.81m	97.8%
25	86.68m	98.8%
26	86.52m	98.6%
27	87.71m	100%
28	86.90m	99.0%
29	85.25m	97.2%
30	83.58m	95.2%

Chart 3



	18	19	20	21	22	23	24	25	26	27	28	29	30
Hammer	84.7	87.3	91.8	93.9	95	97	98.2	97.4	98.4	98.4	100	99.3	99.1
Shot Put	84.4	87.8	90	92.1	96.3	98.1	97.4	99.3	100	99.8	99.4	98.1	98
Javelin	84.3	87.4	91.9	94	96.7	98.1	97.8	98.8	98.6	100	99	97.2	95.2
Discus	81.1	85.8	89.1	89.1	91.6	95	97.1	98.5	99.9	99.9	100	99.9	99.6

Chart 4



	T-10	T-9	T-8	T-7	T-6	T-5	T-4	T-3	T-2	T-1	T
Javelin	81.2	81.3	84.2	84.7	87.3	86.3	87.5	90.4	93.2	96.3	100
Shot Put			86.4	88.8	89.1	89.4	92.4	95.1	95.8	96.8	100
Hammer	88.9	86.4	89.9	91.4	92.9	94.2	95.1	96.1	97.2	96.7	100
Discus	87.5	89.9	87.5	89.6	88.8	90.5	93	93.7	94.8	96.1	100

Don Babbitt is currently the throws coach at the University of Georgia, and has served in this role for the past 19 years. He has also been the CSCS Editor for the throwing events for the IAAF since 2010. As a coach he has guided 48 athletes in major international competitions in all four throwing disciplines. These athletes have gone on to win 19 medals. The most notable of these athletes are 2004 Olympic Shot Put Champion, Adam Nelson, and 2007 World Outdoor Shot Put Champion, Reese Hoffa.

rotational technique and have a virtual monopoly on performances over 22 meters. Perhaps the most likely reason for this development is ability of the rotational technique to suit a wider range of body types/ nervous systems than the glide technique.

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INTERVIEW WITH NANCY HOBBS

MUT RUNNING—GOING THE DISTANCE

We don't often carry artiles about mountain or trail running in *Track Coach*, but Editor Russ Ebbets got in touch with the USATF Council Chair to bring us up to date. Photos courtesy of Nancy Hobbs.

BY RUSS EBBETS, EDITOR, TRACK COACH

■ ***Nancy, what is your current position within USA Track & Field?***

Chairperson of the USATF Mountain Ultra Trail (MUT) Council.

■ ***Can you briefly describe what differentiates mountain from ultra from trail running?***

I'll start with the easy one…Ultra is anything over 26.2 miles. Focusing on mountain and trail secondarily and defining these two disciplines is a bit of a tougher nut to crack. While mountain running is typically defined by surface (non-paved), and elevation gain, a mountain run can be on a road/paved surface if it has significant elevation gain. Trail running is defined by anything off-road (non-paved) and can also be defined with elevation gain and also loss. Keep in mind that many trail and mountain races, although primarily "non-paved," may have segments of paved surface getting to and from the trail, or to spread athletes out as they make their way to the trail. Also, there can be segments in trail races where pavement (even cobblestones, brick, sidewalk, steps), is present—especially in ultras on the international level— if the event goes through villages, or towns on paved terrain getting to and from an aid station, or to and from a trail connection. The surface of a trail can be anything from single track to double track, dirt, grass, rocky terrain, sand, gravel, and more. There can also be natural obstacles such as downed trees on a trail, rocky outcroppings, exposed or covered tree branches and roots, etc. The difficulty of a trail race or mountain race is often categorized by cumulative elevation gain, surface, altitude at which the event is held, and weather conditions.

■ ***Is there much crossover between the disciplines? Or does one tend to specialize in mountain v. trail, for example?***

Yes, absolutely. Many athletes come to trail from a track (steeple is a good entry into the sport due to the constant gear changes and…obstacles), cross country, mountain biking, or ski mountaineering background. And likewise trail runners often cross-train or cross over to the aforementioned.

Joseph Gray at the World Mountain Running Championships in Andorra in 2018.

■ ***What about "seasons?" Are there set times of the year when one discipline is conducted or are events held throughout the year?***

Throughout the year, but…many trail, mountain and ultrarunners cross-train in the winter months on snowy trails possibly snowshoeing, skiing, or ski mountaineering.

■ ***How did you get started in Mountain, Trail or Ultrarunning?***

My career in the sport has included trail running since the 80s. I was involved in race management which included some events on trail starting in the mid-80s. Internationally, in 1995, I wondered why we didn't have a women's team at the World Mountain Running Trophy (now the World Mountain Running Championships). Long story short, I cobbled a team together and we competed in our first international mountain championships in Edinburgh, Scotland. That was the start of the women's team and led to my involvement on a broader level both domestically and internationally especially on the administrative side (although I have been competing on the trails and in the mountains as well, though not at an elite level).

■ ***From a historical standpoint, when did MUT get established within USATF?***

In the late 90s. What is now a council, first started as a sport committee, but always under the long distance running (LDR) umbrella. We have tried to increase the association involvement over the years. It was a slow start, but each year we have more and more associations including trail, mountain, or ultra running in their portfolio. We have grown nationally with championships and also have seen an increase in association and regional championships. Our budget went from a mere $750 to over $90,000 in 2020. It has been a long process…and we still have a long way to go, but we have done a lot with a small group of very dedicated and passionate individuals.

■ ***What are some of the current marquee events? What type of numbers do they draw?***

There are both national and world championships and encompass elites, to mid-packers, and those going after age-group recognition. There are also World Masters mountain running championships held annually for any athletes 35-79. The event typically is held in European mountain towns, or over the fells in the UK.

As many as 1,000 masters athletes have participated and run and scored with their 5-year age group. There is also team competition within the nations and athletes do not have to be nominated by their federation, or run a selection race…all are welcome and the event fields elites to weekend warriors.

On the other end of the spectrum, there is the International U18 Mountain Running Cup for athletes ages 16-17 in the year of competition. Typically 15-18

teams participate in this international event pitting nations against one another over a 4-6-kilometer course. The World Mountain Running Championships has both a classic distance (typically 8K for juniors age 16-19 in the year of competition; and 12K for seniors) and long distance (typically 36-42K). The World Trail Running Championships have been alternating between 50K one year and 85K the next, but the schedule is changing on the international level. In both the mountain championships and trail championships 30-45 countries participate. The teams for these international world championships (U18; mountain; trail) are decided by the national athletic federations. Due to limitations on trails, the numbers are often restricted in domestic and international trail and mountain running events. Having said that, there are mountain and trail races that draw in the thousands (a few domestically, most international).

The USATF junior mountain running team in Argentina, 2019.

■ ***Eating on the run can be its own art form. What are some of the most common foods ingested? What makes for a good foodstuff on the run? What are some no-no's?***

Everyone's tummy is different, but…rule of thumb hydration, electrolytes, easily digested calories. On shorter runs, say those under one hour, hydration is probably the main consideration so as to not get "dehydrated," and to also have a quicker recovery. On longer runs, other nutrition will be added from solid foods to gels and bars, again, depending on what the stomach can handle. Oftentimes, bland foods like boiled potatoes, crackers, and bagels are good—I call it the "white" food group. Adding things like citrus, acidic foods, and colorful foods often lead to GI distress. But again, everyone copes differently with food. Sometimes also flavor fatigue sets in if one focuses on say one flavor of gel for an ultra. Mixing it up seems to work well for many people. Again, recovery being a key ingredient in any training. This means hydrating, fueling, rest, stretching, and core work.

■ ***How much calculation goes into the amount of food eaten during a race? What metric is used—calories/hour, calories in the food, ease of digestion or are the runners finely tuned enough to "know" when to eat and when to stop?***

I'm not a nutritionist and would rather defer to one for this question. I will say that everyone is different and one needs to fine tune their nutrition training just like they do their physical and mental training. It all comes together for a great balance. One of the key takeaways is to not wait until you are thirsty to drink, or hungry…to eat. If this depletion happens, it is often too late in the run or race to play catch-up.

■ ***What about pre-race meals? Carbo loading has come back into favor, but that fuel can only last so long in a four to five hour (or longer) race.***

Everyone is different…again nutritionist. I would say avoiding alcohol or caffeine pre-race makes good sense as these can be diuretics, but again, each athlete has to know their body and what is best for their engine.

■ ***Are heart rate monitors allowed during the race? What about other electronic monitors that can give individual feedback? (altimeters, GPS, wrist phones allowing communication with one's base, etc.)***

Yes, but in national championships via USATF, one must adhere to the rules and regulations governing the discipline.

■ ***Support crews are no doubt critical. What and who make up the support crews for a runner in a MUT race? Are they different for the different disciplines? What would be some of the job descriptions?***

Oftentimes it is friends or family members who serve as aid station crews and typically for ultra-distance events. Having said this, sometimes aid stations are very remote so participants in races can check in drop bags either the evening before a race, or in the morning of a race depending on logistics. Being prepared with hydration and fuel and apparel (i.e., be prepared for the weather as it is and what it may become) is an individual responsibility as well as reading the course map in advance and having a pretty good idea of what is entailed in the course—terrain, distance, elevation, tree cover, exposed areas, etc.

A support crew can include those who help with fuel resupply, massage, helpers to change out shoes and socks, and tracking where the athlete is in relation to the field. As well, mental support in terms of motivation and communication is crucial for long distance efforts.

Some support crews also include "pacers" or "mules" who can join a racer after a certain distance (in a 100 miler, this could be at 50 miles) and help pace the athlete as well as carry fuel and hydration and even extra apparel. There are rules in national championships at ultra-distance prohibiting "pacers" and "mules." There are safety runners allowed in events, but there are rules surrounding how far the "safety runner" must be from the participant.

■ ***Are the rules different for support crews for the different courses (I'm thinking here point-to-point v. loop courses). Who makes the rules for this support—does it come from the USATF Rulebook or are there international rules from the IAAF/WA?***

On the national level, it is pretty much specific and directed by the event. Internationally, a different story. The aid stations are very restrictive to key race personnel supporting from the national federations—typically only one or two people per nation. There are also rules when an athlete can have aid. Not on the open course, but within (usually) 100 meters before and aid station and after an aid station.

■ ***What is the controversy for a trail running using hiking sticks?***

Not really a controversy, each individual event/race director must make a determination as the rules allow for the sticks in trail and some mountain races (although poles have not been allowed at mountain classic distance events). Some of the considerations for a race director may include: are there areas of the course or times during a race where hiking poles/sticks are not allowed; if a runner starts with poles, must he/she carry them the entire way; if one picks up poles at an aid station, must they be carried to the next aid station? Collapsible poles may be the best alternative and, in some trail races there is mandatory gear required by each competitor like headlamp, safety blanket, jacket and wind pants with taped seams, first aid kit, cell phone, and yes, even poles.

■ ***Chronic overuse injuries must be rampant. What are some of the injuries frequently seen? Are there any tricks or prevention or care of these injuries?***

The issues seen by road runners, from IT band strain to lumbar issues and plantar fascia, may all be potential injuries of overuse, or improper balance, favoring one muscle when another is weak, etc. For trail running, add in issues related to falls, ankle or knee sprains and various other "tweaks." One of the items I think is great for trail and mountain runners on challenging terrain or gnarly downhills is to wear gloves. It is very challenging to pick out rocks and gravel embedded in one's hands after a fall. Gloves don't weigh much and have protected many a hand or finger from dangerous tumbles. Trail and mountain runners should incorporate strength training, flexibility exercises, balance exercises and core work into their regimen.

■ ***MUT is very international with worldwide competitions. What are some of the countries that have embraced this discipline and excelled at it? What are some of the international events that have become "destination" events that a MUT runner would like to compete in at least once in his/her career? (I'm thinking Comrades Marathon in South Africa and the like).***

Italians are amazing technical trail runners and speed demons on the downhill. Likewise for France and many other European countries to include Norway (amazing climbers), and the UK (amazing downhillers). Germans and Austrians are also traditionally very good climbers. UTMB (https://utmb-

Nancy Hobbs on the trail

montblanc.com/en/page/1/a-mythical-race,-an-unique-experience.html) is a favorite and bucket list for many as are the many races in the point system to gain access to the crown jewel. The point system set up by the International Trail Running Association (ITRA) includes races all over the world. Skyrunning (https://www.skyrunning.com/) events are also very popular internationally and are often on runner bucket lists as well. There are so many iconic events internationally complete with history, flair, and scenery to inspire.

■ ***Who governs the world championships? Is it IAAF/WA or some other entity?***

WA—both IAU and WMRA under the umbrella as patronized events—via the WMRA for mountain and to a lesser extent trails which is presently via the IAU with technical partner in ITRA. But logistics and governance is evolving with the growth and breadth of the discipline.

■ ***Long distance endurance racing has a storied history in the United States from the 100-mile races in the old Madison Square Garden to the runs across America during the Depression. How much of that history is generally known or talked about with the competitors of the MUT disciplines?***

Some people know the history very well, others not so much. It is great when books or articles come out in the press to celebrate the history.

■ ***Are there any mythic figures from the sport's past? Or is there much discussion about events like the Bunion Derby from the Depression era?***

People seem to be very interested in the present following stars like Courtney Dauwalter, Kilian Jornet and Jim Walmsley among the list. But, there are certainly iconic figures who have paved the trail, so to speak and continue as mentors in the sport. Individuals like Pablo Vigil, Jay Johnson, Matt Carpenter, Dave Dunham, Anita Ortiz, Ann Trason, Magdalena Boulet among them.

■ ***MUT competitions seem to be a natural for the movies and books that can romanticize the subject of running, internal struggles, overcoming obstacles, etc. Is there a short list of movies or books that you have enjoyed?***

I love the Salomon videos and many brands are doing some great video coverage and with the Trail Running Film Festival, more and more short and longer-format films are coming out about events, athletes, and FKTs (Fastest Known Times). https://fastestknowntime.com/

■ ***What about events like the Barkely's Marathon or Big Dog's Backyard Ultra—are these events simply the extreme or are they perpetual challenges one aims for?***

People like these and there are quite a few. Part of it is the challenge aspect, for sure. Virtual now is rather popular. Motivation comes from comparing performances and Strava has had a lot to do with this (and other tracking devices as well).

■ ***Ted Corbitt has to be one of the early legends of the sport. He was from New York City and I remember reading that he routinely ran around Manhattan Island two times in one day. Are***

there any other early men of women who produced outstanding or legendary performances?

Matt Carpenter's Leadville record and his Pikes Peak record are amazing. Kim Dobson's Pikes Peak ascent impressive. There are many outstanding performances in Ann Trason's historic career, and more recently Jim Walmsley.

■ ***Who are some of the current stars in the different disciplines?***

As mentioned above Walmsley, Dauwalter, Joseph Gray, Max King, I could list quite a few here! The website irunfar (https://www.irunfar.com/) does an excellent job of showcasing performances. A great resource to follow the sport and its athletes is the American Trail Running Association (ATRA) (https://trailrunner.com/). Magazines focused on our sport include Trail Runner magazine https://trailrunnermag.com/ and UltraRunning magazine https://ultrarunning.com/. To check out a comprehensive calendar of events, visit ATRA's website with more than 8,000 events dating back to 1996 (https://trailrunner.com) and also UltraSignUp (https://ultrasignup.com/).

■ ***Recovery—what are some of the recovery strategies runner's use? How often can a runner race a 50-miler or 100-miler in a year or career for that matter?***

Recovery is critical to long-term enjoyment of our sport. This includes rest, time off, and/or cross training. Strength and balance, core and flexibility should all be facets of an athlete's recovery plan. There are quite a few great tools athletes can use to "self-massage" from foam rollers, slant boards, rapid recovery boots, balance boards among them. As well, having a go-to massage therapist and physical therapist on speed dial is a good idea! Some athletes do stepping stone races throughout the year leading up to a goal race. Other athletes peak more than once in a year as they focus on certain key races. Using the one-day-per-mile-raced in a recovery plan is a good general rule of thumb, but I haven't seen too many athletes incorporate this strategy.

■ ***Footwear—is there anything special about the footwear a MUT runner wears? Arch supports or is all this about personal choice?***

With so many different options, it really comes down to personal choice in the fit, feel, and performance spectrum. Again, every athlete is different and one shoe may be better than another depending on pronation, supination, arch, width, imbalances, and more. Oftentimes lighter runners can get away with lighter footwear, but, depending on the terrain most visited, it may be worth investing in several different types of shoes. One for technical terrain that is more grippy and supportive, one for fast ascents that is lighter in weight, yet still grippy and supportive, one that is an all-around great shoe for getting to and from the trail in training that performs well on most surfaces. Shoes with a rock plate are preferred by some runners, others still like well-cushioned shoe for their ride over the rocks, stones, and tree roots. To consider: Grip, support, weight, cushion, stability.

■ ***Associative v. dissociative thought—running for long periods of time allows the mind to wander, called dissociative thought, possibly creating a trance-like state. Conversely associative thought is an awareness and regulation of one's internal and external environment, as much as possible. Although polar opposites, both could be either positive or negative in terms of performance with one extreme allowing a runner to "run themselves into oblivion" and the other causing one to "think too much." I see this dichotomy as a particular psychological challenge of the sport. Is this widely discussed? Are there adherents to one type of thought over the other?***

I have heard of runners seeing hallucinations, or weird objects in their field of vision when they are very tired during a long run, or race, especially at night. I do think that anyone who spends a lot of time running has a variety of thoughts going through his/her head while doing the activity. It's often a good time to ruminate over issues and consider solutions to problems I suppose, but it is very important to pay attention to the terrain underfoot. A wandering mind can often result in a lack of focus and an impending fall. One great thing about trail and mountain running is the places you can experience and the scenery and vistas you can enjoy all while getting quality time in the out-of-doors.

■ ***All sports generate inspirational stories of seemingly "average" people who have endured and overcome. But there also seems to be a never-ending group of cheaters. Of late several***

marathons (Derek Murphy's Marathon Investigation technology) have "outed" numerous cheaters with irrefutable evidence documenting the cheating. What are some of the steps races take to identify the cheats?

At races, having a combination of video and course marshalls is helpful, but this can't be done on every step of a 100-mile race. GPS and live-time tracking applications are helpful not only in terms of safety, but also to insure that an athlete hasn't strayed from the course.

■ ***What about drug use? I could see the abuse of pain killers and possibly blood doping but is there any psychoactive drug use? How strictly is all this monitored? What about things like caffeine?***

This topic probably needs a separate article. There has been an increase over the years in the number of tests geared to trail and mountain runners and there have been positive cases in the discipline. Most testing has been done in competition, but is also very expensive and restrictive to most race budgets. Testing is typically performed at events on international circuits like the World Cup, or at a World Championships.

The USATF Mountain Ultra Trail Council has been allotted a budget for some testing at its national championships, but only in the past two years. Out-of-competition testing has not been prevalent, again due to cost. Some athletes competing at the highest level internationally have been in the out-of-competition testing pool. Those who have won a world championship or those who excel or compete at more than one discipline like road, track, cross country could also get selected for the out-of-competition pool.

■ ***Closing statement—you can pose your own question and answer it or make a general statement of something I didn't address.***

We should always keep in mind how fortunate we are to have access to the trails we love. As such, we all need to consider maintenance—getting out with boots on the ground, or providing monetary support, or being on a parks and trails committee. Sustainability, climate action, and community should all be part of our vernacular. Many trails are being loved to death, so we all need to do our part to love our trails to health! Get involved in plogging…picking up trash while you are running. Contact land managers to report downed trees, or trail obstacles. Don't run on trails when they are full of mud and debris from excessive rain, or snow melt. Obey "do not enter" signs at trail heads, or closures of trails due to animal migration, or erosion.

Nancy Hobbs has been running trails and directing running events since the mid-80s and her articles and photographs about the sport have been published in magazines including *Runner's World, Running Times, Trail Runner,* and *Ultrarunning* magazine. Along with Adam W. Chase, Hobbs is the co-author of **The Ultimate Guide to Trail Running; Best Trail Runs: Seattle; Best Trail Runs: Denver, Boulder, Colorado Springs; Best Trail Runs: Portland; Best Trail Runs: San Francisco.** She is the founder and executive director of the American Trail Running Association, a council member of the World Mountain Running Association, and chairperson of the USATF Mountain Ultra Trail Council. She was inducted into the Colorado Running Hall of Fame in 2013. She lives in Colorado Springs, CO, but travels extensively nationally and worldwide to support and promote trail and mountain running.

PUSH-OFF— AN INDICATOR FOR TECHNICAL EFFICIENCY IN THE POLE VAULT

BY NOAH KAMINSKY

Bar clearance is 80% runway speed in the pole vault. The remaining 20% derives from the athlete's use of the pole. Since technique varies considerably throughout the global pole vault community, this article does not aim to promote one style of the vault over another. Instead, it offers one measure of technical proficiency that everyone should monitor in training and competition.

Call it proficiency, call it efficiency, call it plain old technique. If you're not tracking an athlete's "push-off," then you're missing a critical factor of that last 20%.

Push-off is the difference between the bar to be cleared and the athlete's top hand grip on the pole, with an additional 8 inches added to account for the plant box depression. Push-off measures how well the athlete utilizes the pole. The greater the push-off, the more efficient the athlete is with the pole.

Push-off can be negative or positive. Generally, beginners start with higher grips than the bar they need to clear and they produce negative push-off. As athletes progress, they become faster, stronger and more technically proficient, which increases their push-off.

Although push-off might appear to matter only once the athlete leaves the ground, all of the preceding phases of the jump contribute to an athlete's push-off. Each phase supports the quality and execution of the next phase, in this sequence:

1. Pole Carry
2. Run
3. Plant
4. Takeoff

For example, a shaky Pole Carry can ruin the Run, which then prevents an athlete from planting or jumping up proficiently. If the athlete doesn't hook up with the pole to meet its unbending, then he/she will not push off the pole adequately either.

Any number of deficiencies can reduce how much an athlete pushes off so it's critical for coaches to consider more than just push-off

alone. Any athletes can produce poor push-off if they don't jump up at takeoff. This is called "getting ripped off the ground."

Either the athlete jumps up after the pole tip hits the back of the box, or he doesn't jump up at all. Getting ripped off the ground ignores the athlete's ability to jump up and the potential for higher grip. Athletes who favor this takeoff style have accommodated this habit through years of practice because their speed and strength conveniently mask their technical deficiencies. Again, when 80% of bar clearance is speed, it's easy to hide technical deficiencies like poor push-off.

Push-off is a simple calculation. Every vaulter should know how high he/she grips the pole. Every pole vault coach should know approximately what grip height their athletes use in practice and in competition. Thus, the coach can calculate the push-off after any successful bar clearance. During the warm-up, a vaulter's grip should gradually increase as he loosens up on the runway. The grip may further increase during the competition, stay the same, or decrease in response to fatigue.

In any competition, grip heights change frequently because the coach will adjust the grip to the athlete's present performance. Ideally, speed and technique are on point during a competition, but any number of factors on the day of, or leading up to competition, may affect athletic performance. Adjustments are necessary.

Push-off isn't as easy to determine when you're watching someone else's athlete. It's not impossible to calculate, but it's certainly more challenging. Your perspective, or the camera angle, may limit your ability to estimate an athlete's grip. While watching an elite competition, you will often observe a range of push-off numbers because professional vaulters rely on different styles. Some professional athletes emphasize their runway speed more than technique.

PUSH-OFF IS A SIMPLE CALCULATION. EVERY VAULTER SHOULD KNOW HOW HIGH HE/SHE GRIPS THE POLE.

For example, in the 2018 season, Canadian Shawnacy Barber jumped on 5.38-meter poles, which are the longest poles ever jumped on by any vaulter. Although Barber's sprint performances are unavailable online, there are sprint performances available from the current WR holder, Armand Duplantis, and other former WR holders, like Renaud Lavillenie and Sergey Bubka. Duplantis ran the 100m dash in 10.6 seconds during his senior season in high school. Lavillenie ran 60m in 6.63 seconds and 100m in 11.05 seconds. Bubka's sprint performances are a little harder to uncover online, but he supposedly ran 100m in 10.2 seconds. As fast as these vaulters are (or were), none of them ever gripped as high as Barber has. Bubka, Duplantis and Lavillenie had higher push-off numbers than Barber because they jumped on slightly smaller poles with lower grips. They were more efficient!

Push-off in the modern fiberglass era ranges between 0-24 inches for youth athletes and 24-48 inches for older athletes. Surprisingly, prior to the use of fiberglass poles, these averages were remarkably the same, or better, for the best vaulters. Ken Doherty's *Track & Field Omnibook* (2nd ed.), published in 1972, reports an average grip height of 13 ft 2 in for pre-fiberglass vaulters for an average bar clearance of 15 ft 2 in. This suggests pre-fiberglass vaulters jumped over their grip with an average push-off of 32 in. When fiberglass was introduced, the average clearance height increased to 16 ft 9.5 in, and grip heights increased to an average of 14 ft 10 in. Although athletes could hold the pole higher than ever before, the differences calculated between respective grip height and bar clearance remained nearly identical. In other words, athletes could jump higher, but they remained similarly efficient with their use of the pole.

As with all innovative change in sports, the transition to fiberglass brought about controversy because "its opponents claimed that performance now was an effect of the catapult action of a machine rather than of human ability." While this may be true for increasing grip height on the pole, the "catapulting effect" provided no immediate benefit to the athlete's ability to jump above their grip. Push-off saw no remarkable change between the pre-fiberglass and the modern era of pole vault. Today, straight-pole jumping drills are just as valuable as they were to athletes who used stiff poles made of bamboo, aluminum or steel.

As noted earlier, measuring push-off for professional vaulters is challenging because this data is not widely available or often recorded. Though pole specs are infrequently available, some of this informa-

tion has emerged over the past several decades from sources like the online forum PoleVaultPower, various educational seminars, and interviews with athletes and their coaches. Bubka has been helpful to the pole vault community because his performance data is more available than most other vaulters. Today, he continues to champion sports education in his home country, Ukraine, and to the next generation of Olympic hopefuls worldwide.

THE HIGHEST BAR CLEARED REMAINS OUR PERFORMANCE GOLD STANDARD. THIS SHOULD NOT CHANGE.

In 1984, Bubka gripped 16 ft 9.5 in and jumped 19 ft 9 in. When accounting for the 8-inch dip in the plant box, his push-off was 43.5 inches, or 3 ft 7.5 in. In 1991, when Bubka jumped his final WR, his push-off was 40 inches, indicating that he ran incredibly well on the runway and utilized the 5.10m pole only slightly less efficiently than 7 years prior. If Bubka gripped the same height in 1991, and produced the same push-off from 1984, then he would have cleared 20 ft 5 in or 6.22m, which is 4 centimeters higher than Duplantis' current WR. However, numerous other factors influence any given performance and it's unreasonable to posit what's possible from the numbers alone. I hope this brief look at Sergey Bubka's performances offers a mandate for coaches and athletes to track their push-off over time.

The highest bar cleared remains our performance gold standard. This should not change. However, it is not the only measure of ability. Push-off measures an athlete's technical efficiency. Push-off offers perspective on an athlete's bar clearance potential. Tracking and monitoring push-off allows coaches and athletes to assess progress. If an athlete jumps higher, while his push-off decreases, then he may have gained speed on the runway at the cost of technical proficiency. Alternatively, if an athlete jumps the same, or clears a lower bar, but his push-off increases, then he may have lost speed, but remain technically proficient. Both are necessary to create sustainable progress in the pole vault.

When 80% of the jump is produced from an athlete's speed, it may seem less important to coach the last 20%. Even with the most effective training, athletes, male or female, have genetic limits which prevent them from producing enough speed to roll their pole to vertical. A vaulter's grip cannot increase indefinitely. The tradeoff between grip height and safety is not worth the liability. Grip should progress when vaulters consistently overcome pole resistance and they land safely in the pit. Until then, keep the grip fit to the vaulter's ability. Teach them how to get their hips above their grip. Teach them how to push off!

WHEN TO INTRODUCE BODY CONDITIONING?

STRENGTH AND CONDITIONING ARE CRUCIAL TO DEVELOPMENT BUT MUST BE AGE-APPROPRIATE. SO WHAT AGE SHOULD ATHLETES START?

This piece was excerpted from Athletic Weekly, *February 2, 2017.*

Strength and conditioning young athletes is a controversial coaching issue around which fact is often confused with fallacy. Questions abound about its safety and whether it is appropriate in terms of an athlete's physical and biological development.

In an attempt to set the record straight, Professor Avery Faigenbaum, an exercise scientist at The College of New Jersey, reviewed the evidence on behalf of the American College of Sports Medicine last year [2016]. "The belief that strength training is unsafe for children is not consistent with the needs of boys and girls and the documented risks associated with this type of training," he wrote. "However, strength training is a specialized method of conditioning that requires qualified supervision, appropriate overload, gradual progression, and adequate recovery between exercise sessions."

So when and how should you be introducing conditioning? A survey of coaches conducted on behalf of UK Athletics a few years ago, reported that circuit training was the most popular strengthbuilding approach used with young athletes, usually from the age of 15 onwards, but with some coaches implementing it with athletes as young as 13.

Weight training was the second most popular method, being used by two-thirds of the coaches, but not before the age of 16. About half of those polled used plyometrics and gym machines occasionally with athletes of 15 and over, and a few made regular use of medicine balls. We asked an expert when to introduce what:

PRE-PUBERTY

Even before an athlete reaches puberty, some conditioning work can be incorporated into the overall training plan. "At this stage, low level bodyweight circuits, medicine ball and resistance band work are ideal," says endurance coach David Lowes.

"The emphasis should be on sets of high repetitions at a low resistance. Technique and lifting can be started early, but with a bar or pole only."

Exercises done pre-puberty should be done carefully with an avoidance of a full range of movement. "In the

case of a sit-up, for example, the exercise should be done smoothly and with bent knees to the point where the elbows slide to the knees and the head remains fixed looking at the ceiling to avoid lower back and neck problems," Lowes explains.

"Half squats are much better for youngsters to relieve the stresses on the knees and more so if any weight is added." Above all, it is technique that should be the focus at this stage. "A simple 1-2kg medicine ball routine with 4-6 all-round exercises may be of more benefit at a young age," Lowes says. "It allows exercises to be monitored and modified easily by the coach."

ADOLESCENCE

A peak growth spurt that coincides with the onset of the sexual development associated with adolescence generally occurs at around age 11-14 in girls and 12-16 in boys.

Girls tend to have a strength window at around the age of 13 whereas for boys it comes closer to the age of 15.

At this stage, conditioning work focusing on shoulder, elbow, core, spine and ankle stabilization should complement bodyweight exercises and moves using weighted medicine balls and stability balls. It's also a good time to introduce the basics of weightlifting techniques.

POST-PUBERTY

When girls are around 14-16 and boys 16-18 the all-important strength window for males remains open and females are nearing the end of a second strength window. This is the time to introduce Olympic lifting and plyometrics for both, always keeping in mind the differing biological ages of training and the development stages of your athlete.

SEE HOW THEY GROW

- **3-6 years (pre-school):** rapid physical growth and brain development.
- **6-12 years (school age):** slow physical growth and steady brain development.
- **12-17 years (adolescence and puberty):** rapid physical growth. Initially, rapid and then steady brain development.
- **17+ (early adulthood):** slow physical growth and steady brain development.

USATF COACHING EDUCATION

USATF COACHING EDUCATION TO CONTINUE ON ZOOM INDEFINITELY

For the health and safety of our instructors, participants, and the local communities where schools are conducted, USATF leadership has decided to indefinitely continue conducting all USATF Coaching Education programs online amid ongoing COVID-19 concerns. This decision was made with support of the Coaching Education Executive Committee.

Since June, USATF has piloted offering coaching education courses on Zoom, including the first-ever Level 1 and 2 Schools. By committing to an online format this will best allow programs to continue to be offered on a regular basis and in a safe manner.

Individuals who pre-registered for a scheduled in-person school will be transferred to an online alternative or issued a full refund.

Visit the USATF Calendar of Schools and USATF Campus for the latest in online programming options.

For up-to-date information on COVID-19 gathered by USATF's Working Group, visit USATF.org/covid19.

USATF CALENDAR OF SCHOOLS

https://www.usatf.org/programs/coaches/calendar-of-schools

Oct 2-5	Level 1 Zoom #10 – Eastern Time
Oct 9-12	Level 1 Zoom #11 – Mountain Time
Oct 23-26	Level 1 Zoom #13 – Eastern Time
Nov 6-9	Level 1 Zoom #14 – Pacific Time
Nov 13-16	Level 1 Zoom #15 – Central Time
Nov 20-23	Level 1 Zoom #16 – Eastern Time
Dec 11-14	Level 1 Zoom #20 – Eastern Time
Dec 11-14	Level 1 Zoom #21 – Central Time
Dec 18-21	Level 1 Zoom #22 – Eastern Time
Dec 18-21	Level 1 Zoom #23 – Pacific Time
Dec 27-31	Level 2 – Event Specific School

ANNOUNCING A WINTER SESSION USATF LEVEL 2 SCHOOL ON ZOOM

USATF Coaching Education is pleased to announce a second USATF Level 2 School to close out 2020. The course will be conducted on Zoom December 27-31, 2020. Applications are anticipated to open the week of October 5th and program details will be posted to the Calendar of Schools on USATF.org.

USATF members with a current Level 1 certification and a minimum of three years coaching experience (track & field, cross country, club or personal run coach) are eligible to apply. The USATF Level 2 School provides an in-depth education in a singular event-group and the knowledge to write a comprehensive training plan. Individuals can choose to enroll in Endurance, Sprints/Hurdles/Relays, Jumps, Throws or Youth Specialization. Enrollment caps will apply, and early application is advised for placement in first-choice event-group. Nearly 250 USATF members from across the USA (and globally) converged to complete the pilot Level 2 School during the summer.

USATF LEVEL 1 RECERTIFICATION APPLICATION OPENING IN OCTOBER

USATF members seeking to renew a current Level 1 certification may soon apply for recertification. Members may verify their certificate expiration date according to the schedule below or by logging into USATF Campus (certificates are available under Transcripts).

Earned	Expiration
January 1, 2013-June 30, 2019	December 31, 2020
July 1, 2019 – December 31, 2020 (waiver period)	December 31, 2024

Members who completed a Level 1 during the waiver period do not need to take any action until the next recertification period. Level 2 and 3 coaches remain exempt from recertification and no action is necessary.

Application Instructions

1. Renew USATF membership for 2020
2. Complete latest SafeSport Training (must be current through 12/31) — **NEW requirement**
3. Complete an approved recertification course* (choose one)
    a. USATF Campus Course
    b. USATF Learn By Doing Clinic (2017)
    c. USATF Cross Country Specialist Course
    d. USATF Emerging Elite Coaches Camp
    e. USATF Level 2 Sports Science Classroom
    f. Complete a new USATF Level 1 School
4. Submit recertification application and processing fee
5. Verified by national office (allow five business days)
6. New certificate awarded on USATF Campus upon approval

You must complete steps 1-3 before accessing the recertification application. Please do not email copies of your certificates unless requested. Any application received after 12/31/2020 will be accessed a late fee.

**Recertification course must be completed both after Level 1 certificate was last attained and quad start (January 1, 2017). No credit will be provided for any courses completed prior to (last) Level 1 certificate date.*

SAVE $10 OFF YOUR USATF CAMPUS ORDER THROUGH OCTOBER 31

USATF Campus is the online learning platform available to all coaches, athletes, and educators with an interest in better understanding human performance. With over ten sports science courses available, coaches from all track and field and endurance disciplines can tailor their learning and continuing education to their interests.

For a limited time, USATF members can save $10 off their USATF Campus order with promo code: TrackCoach10 (enter coupon code in the shopping cart and click apply). Members with an expiring Level 1 certificate in 2020 and students are especially encouraged to take advantage of this limited time offer.

Featured Courses

- Basic Science of Sprinting
- Chronic Fatigue Due to Overtraining
- Physiological Development Through the Athlete's Lifespan
- Reactive Strength (Plyometric Training), Pt 1 and 2
- Skill Acquisition: Movement Technique Analysis
- Sport Specific Strength and Power
- Training Science

Exclusions: Course bundles, Basic Principles of Endurance Training and the Level 2 Sports Science Classroom are excluded from the promotion. Promo code must be redeemed by October 31, 2020.

View all courses at: https://usatfcampus.myabsorb.com/#/catalog

EARN CEU'S FROM INDIANA UNIVERSITY, BLOOMINGTON FOR COMPLETION OF USATF COURSEWORK

In partnership with the Department of Kinesiology, School of Public Health–Bloomington, Indiana University, USATF offers CEUs (continuing education units) to individuals seeking to obtain credit for courses offered by the USATF Coaching Education Department. This partnership demonstrates a higher education endorsement of the provided content. Members are responsible for determining if CEUs will be accepted by their licensing agency or affiliated organization; and should note the CEU certificate does not provide a transcript nor college transfer credit. CEU certificates are commonly accepted for teacher license renewal and other National Governing Bodies (NGB) professional pathway courses.

Eligible USATF Coaching Education courses include:

- USATF Level 1 – 2 CEUS
- USATF Level 2 – Sports Science Classroom – 1 CEU
- USATF Level 2 – Event Specific – 3 CEUS
- USATF Cross Country Specialist Course – 1 CEU
- Any combination of two courses on USATF Campus – 1 CEU

Interested individuals can learn more and submit an application (fee applies) at the link below. Please note the CEU request form should not be completed until you have separately enrolled and completed an eligible course listed.

https://www.usatf.org/programs/coaches/earn-ceu-s

2021 NATIONAL TEAM STAFF APPLICATIONS OPEN

USATF is accepting applications for National Team Head Coach, Assistant Coach, Head Manager, and Event Manager positions for 2021 National Teams. Applications must be submitted no later than October 30, 2020. Selections are governed by Regulation 17 of the bylaws of USATF. Please see below for a list of the teams and a link to the selection procedures and applications.

All individuals must submit an application to be eligible for consideration for a team staff position - even if you have submitted an application for teams and/or served on a team in prior years.

A current USATF membership number is needed to access the application. Please note, as part of the application process, applicants are required to upload a full-color passport-style headshot photo.

- **2021 Non-World Major Competition Teams**
  - 2021 World Athletics Indoor Championships - Nanjing, China (March 19 - 21)
  - 2021 World Athletics Relays – Silesia, Poland (May 1 - 2)
  - 2021 NACAC U23 Championships – Nassau, Bahamas TBC (July 9 - 11)
  - 2021 Pan Am U20 Championships – Santiago, Chile (July 23 - 25)

Applications

To access either the coaching staff or managerial staff selection procedures, eligibility criteria and applications for the 2021 Non-World Major Competition Teams visit:

https://www.usatf.org/programs/elite-athletes/team-usatf/staff-applications-procedures.

Applications must be submitted no later than FRIDAY, October 30, 2020.

Contact Kimberly Sims at Kimberly.Sims@usatf.org for questions concerning the application and selection process.

TRACK TECHNIQUE/ TRACK COACH CONTENTS

TRACK TECHNIQUE/TRACK COACH BACK ISSUES. The issues listed below are the only remaining issues of the printed issues. If an issue is not listed, it is out of print and unavailable. These issues are available singly for $5.50 apiece postage-paid for U.S. delivery; $8.00 apiece postage-paid for foreign delivery. Order 5-9 issues, pay $4.00 apiece; 10 or more issues, $3.00 each, postage-paid. Non-U.S. orders—add $2.00 shipping per copy. Some issues are in short supply, so order early. Visa/MC/Amex orders accepted by phone: 650/948-8188 9 am-5 pm PT, M-F. Note: The periodical's name was changed from *Track Technique* to *Track Coach* with issue #131 (Spring 1995). Listed below are a few of the more prominent articles in each issue. There are more useful contributions in each number.

A one-year DIGITAL subscription (four issues) is $19.95 U.S. and foreign. *Effective with our Winter 2015 Issue #210, Track Coach became available by electronic format only. Digital issues will be sent to the email address used for placing your order.* **Order from:** Track & Field News, 2570 W. El Camino Real, Suite 220, Mountain View, CA 94040 USA. Email: subs@trackandfieldnews.com.

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Distance Training Analysis with the Mac Computer, Tony Sandoval
Model Technique in the LJ, Günter Tidow
Results from TAC Junior Elite Sprint Camp

No. 119, Spring, 1992

Load Variations of Elite Female Javelin Throwers in a Macrocycle, Jianrong
Kinematic Analysis of Syedikh's WR, R. Otto

No. 152, Summer 2000

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Scott Christensen
Accuracy in the Horizontal Jumps Approach, Rubin
Sprint Observations, Kirk Reynolds

No. 154, Winter, 2001

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Management of Risk in PV, Jan Johnson
USATF Level I Coaching Education Program, Carolyn Ross & Troy Engle

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Sprint Start Positioning, Karen Helmick

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No. 176, Summer, 2006

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