Sports Scientists Train Athletes to Defy Old Limits

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In this article, Jay Stuller explores the field of sports science and its role in training athletes to surpass previous performance limits. The article highlights the story of Bob Beamon, who set a long jump record at the 1968 Olympic Games, and how sports scientists are using technology and research to understand and enhance athletic performance. The article discusses the use of treadmills, test tubes, and computers to analyze neuromuscular functions, and the potential of sports science to improve athletes' performances at all levels. It also touches on the psychological aspects of athletic performance and the potential dangers of steroid use. The article suggests that while sports science has already begun producing better athletes, it is still a relatively unsophisticated science with much room for future development.

The article discusses the role of sports science in enhancing athletic performance. It highlights the use of anabolic steroids, despite their potential health risks, as a means to improve muscle strength and bulk. The article also explores the potential of nutritional methods to stimulate ATP production, which could enhance an athlete's performance. The piece features Dr. Gideon Ariel, a former discus thrower and member of the Israeli Olympic team, who uses computer technology to analyze and improve athletes' performance. Ariel's work with Al Oerter, a four-time Olympic gold medal winner in the discus, is highlighted as an example of how sports science can help athletes improve their technique and performance.

Below find a reprint of the 11 relevant pages of the article "Sports Scientists Train Athletes to Defy Old Limits" in "Smithsonian":

The timeless striving of athletes to break records of the past and extend limits of human performance

By Jay Stuller

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Was it? Did Bob Beamon reach the limits of human athletic performance on that October day in 1968? In the past, questions like these were likely to be settled by an argument and a wager. But a new field of research into the nature of athletic performance is providing a more scientific basis for the answers. Sports and exercise scientists are measuring and testing everything from athletes' muscle twitches to their mental traits, redesigning their diets and analyzing their physical movements by computer. Although sports science cannot yet predict whether a record like Beamon's will ever be broken, the information accumulated by analyzing outstanding athletes is benefiting aspiring athletes and improving their performances at all levels of competition.

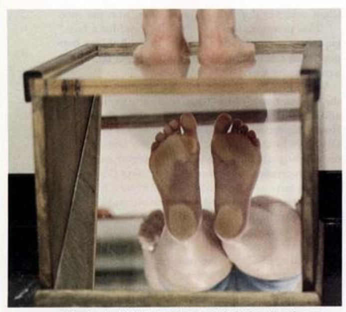
In a sense, the development of sports science is an extension of the older discipline of sports medicine, which can trace its origins to the ancient Greek Olympics. Greek physicians called "gymnasts" were involved in all aspects of an athlete's training. One of the most renowned was Herodicus who was, purportedly, the teacher of Hippocrates, the father of medicine. The American College of Sports Medicine, founded in 1955, continues this tradition with a wide range of physicians and other specialists as members (including dentists, podiatrists, osteopaths, even veterinarians).

But sports scientists are now interested in far more than the prevention and treatment of injuries. At laboratories from coast to coast, they are studying athletes' physiology, biomechanics, biochemistry, psychology, kinesiology (the science of movement)—from toe to teeth.

An underlying assumption of sports science is that by analyzing the elements of athletic prowess, it should be possible to teach athletes to perform better. But how much room for improvement is there?

In 1934, young Brutus Hamilton, later the track coach at the University of California, Berkeley, set forth what he thought would be the "absolute ulti-

Jay Stuller is a free-lance writer whose sports career as a college basketball player lasted two years.



A device in Clein's lab shows weight distribution on feet, seen in mirror; test is for posture problems.

There are many other traits Clein looks at, such as differences in muscle fibers, termed "fast-twitch" and "slow-twitch" fibers. A fast-twitch fiber reacts well to sports that require fast work of high intensity and short duration, such as sprinting; a slow-twitch fiber is better for sports that require endurance, such as marathon running.

In his Denver laboratory, Clein carefully studies an individual before recommending any performance-improving program, because each athlete has distinctly different needs. It may involve the kind of fine tuning needed by the Cleveland Indians' third baseman Toby Harrah, who had thigh muscles in one leg that were weaker than those in the other. Or Clein may work a complete transformation, as in the case of Leslie Covillo, a gangly 14-year-old when she came to him three years ago.

She wanted to be a runner and was hoping to go out for her junior high track team, but at first glance that hope appeared futile. She didn't know how to run and could not sprint efficiently in a straight line. She was tall and awkward, with painfully weak legs. "Those long legs are long levers," explains Clein, "but Leslie didn't have the muscle mass to move them properly. But as our tests progressed we found she had the things that gave her a mechanical advantage on the track: a great nervous system and the perfect body build for running."

These traits were not, however, obvious at a glance. Clein put Covillo through a series of tests, checking neuromuscular functions such as her "righting" reflex, seeing how quickly she could catch her balance when her equilibrium was disturbed, and her reaction time, seeing how fast she could respond to visual or auditory cues. There were exams on how she processed such information and psychological tests of her aggression, need for dominance and self-assuredness. "We also looked into her family background," says Clein, "to determine if it was supportive and encouraging. Which it was."

There were also measurements of the physical characteristics that separate the champions from the ordinary. "We looked at the length of her lower leg in relation to her upper leg," says Clein. "The width of her shoulders and hips, the length of her waist. All these factors have to be compared with her body mass. And then we compared her characteristics with what sprinters must do and the mechanical advantage they need for their sport." Covillo qualified.

"We had to evaluate her strengths and weaknesses," Clein says, "and then consult the research to see what she should do. First, she didn't have the muscle mass to move those levers, so we put her on a resistance program to increase her overall body power."

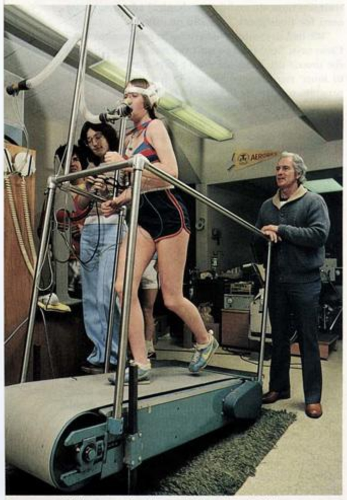
Curiously, not once during the six-month laboratory workout did Clein put Covillo on a track or time her in a race. "It was best to build that physiological base of success here," he explains. It also helped her psychologically, not allowing her to go to a track and have a bad experience. "As we retested her, she could make goals for herself here." Clein also taught her the art of dissipating nervous tension and relaxing.

Running while lying down

Because tension affects motor performance, Clein prescribed a special exercise for Covillo, a visualization of the races she would win. With his student lying on the floor, eyes closed, arms relaxed at her sides, Clein talked:

"You're tense, Leslie," he said. "You see the other competitors next to you. You feel the pressure, but you start to let it go. Feel the tension leave your body." Covillo's hands tensed, she relaxed her fist and wiggled her fingers. "You can feel it leaving your neck. Your shoulders get loose." Covillo twitched her shoulders, then rotated smoothly. "Okay, now you don't see the other runners, they disappear. They're not there anymore and it's you on the track. You're in the blocks. Ready, go!"

Covillo's knees pumped furiously as she flopped on the floor in an imitation of running while lying on her back. The style of the mimicry did not matter, for the race was in her mind. Then she stopped, and



To improve her figure skating, Lynn Smith runs on treadmill for Dr. Ogilvie's biomechanical evaluation.

Clein told her she'd run a good time, won the race.

"This programs the body and the mind for a race," explains Clein. "It sets a pattern of good things happening so she can get rid of that nervous tension in a competitive situation."

When Covillo did go out for her junior high squad, she set five records in her first year. She won the 100- and 200-meter races in the Amateur Athletic Union's Rocky Mountain Division and qualified for the Junior Olympics in three events. Now 17, she intends to go on running at the University of Oregon next year. "Her progression has slowed down," says Clein, "but she does have all the characteristics to be a high-class runner. She might have done OK if we hadn't tested her and put her on a special program, but she would not have done as much with all that innate talent."

The psychological factors that are a critical part of the training in Clein's lab become even more important in competition at the top of a sport. The psychology of record breaking is obviously inexact, but it is a terrible and sometimes frightening factor.

Dr. Bruce C. Ogilvie, a 59-year-old sports psychologist and professor emeritus at San Jose State who frequently works with Clein, has probed the minds of thousands of athletes, in questionnaires and lengthy interviews. He has consulted with numerous professional, college and Olympic teams and conducted personal counseling sessions with athletes who felt they had a mental block. In the 1980 Winter Olympics at Lake Placid, U.S. figure skater David Santee expressed effusive and public thanks for the help Ogilvie had given him.

The art of mental skating

"Athletes are basically an emotionally healthy group," says Ogilvie, "but the main mental interference in performance is self-doubt. And I don't think there is any athlete, gold medalist or not, who hasn't experienced self-doubt at one time or another."

When necessary, Ogilvie will sit with an athlete in exhaustive sessions that may last 18 hours. "The block is often subconscious," says Ogilvie, "but what we do is create a routine of positive actions where everything goes perfectly. We have the athlete rehearse this in the mind, a visual image of the performance."

Santee went through mental skating programs, including the one that nearly won him the bronze medal at Lake Placid. "David had experienced a near-total collapse in self-confidence," explains Ogilvie. "He'd had a series of unfortunate performances in a row, which build up in intensity. In this situation, one starts pressing, which makes it quite difficult to capitalize on motor gifts. And David has wonderful motor gifts, a beautiful set of genes for the sport."

Ogilvie relaxes San Jose State baseball player Mitch Buich jr. as part of mental batting practice.

Santee, however, had lapsed into an attitude of passivity, and had lost his once-commanding presence on the ice. "We wanted to regenerate that deep feeling of self-affirmation," says Ogilvie. "We wanted to eliminate anything tentative in his approach." In the Games Santee fairly sparkled with ebullience.

For other athletes, improvement may come from understanding physical problems they could not see themselves. Dr. Gideon Ariel, who has specialized in both computer science and exercise science, is training the athlete's neurological patterns and functions as well as the traditional muscular functions by applying computer technology to sports.

The 41-year-old Ariel, a former discus thrower and member of the Israeli Olympic team, has a sports research center near Trabuca Canyon, California, and also conducts studies at CBA (Computerized Biomechanical Analysis, Inc.) in Amherst, Massachusetts. A current prize pupil is Al Oerter, the 43-year-old, four-time Olympic gold medal winner in the discus, who retired after the 1968 Games and is now making an amazing comeback. Oerter's longest Olympic throw was 212.6 feet (the current record is 233.5).

When he came to me 14 months ago," says Ariel, "we took some high-speed film of him throwing and compared his performance with those of previous years. He is slower, of course; age has slowed him down. But what we noticed was how inefficiently he had been throwing. He released the discus at the wrong angle, causing the throwing forces to be misdirected. The angle of his arm relative to his trunk was wrong for maximum leverage and his feet were leaving the ground when he needed maximum contact with the throwing circle. He was throwing only 180 feet when he came to us."

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Using the computer and exercises to work on Oerter's neurological patterns—you train the muscles and the nerves, says Ariel—Oerter is much closer to his optimal performance. That may not be as high as some of the younger throwers, who may have a better biological advantage, but Oerter is now throwing 221.4 feet, far better than he did during his "prime."

If sports science has already begun producing better athletes, it is still a relatively unsophisticated science, and its developing techniques will undoubtedly produce even better results in the future. The use of steroids is an example.

Pill parity in the steroid race

Anabolic steroids are basically androgens, or male hormones, which help build muscle bulk and strength and are favored by athletes in many events from weight lifting, the shot put and discus to, more recently, running. Although illegal by international athletic rules (testing is conducted at all major international meets and during the Olympics) and available by prescription only, many athletes take them indiscriminately, with the attitude that "if two pills (or injections) are good, ten can get them a medal."

And this has them flirting with potentially dire consequences; prolonged and overuse of steroids can lead to sterility and sexual dysfunction. In some East-ern European nations, elite young female athletes are said to be given hearty doses of the substance at key points in their careers. In the United States, athletes take steroids by choice, but the effect is quite similar to an arms race; if the Soviet throwers are getting so many steroids a day, an American must have pill parity or lose. "You can't be world-class without steroids," says one flatly. But Ariel sees sports science as only at the first stage of understanding such chemicals. "Next is looking at the chemistry of the body," he says. "And I hope it can be done naturally.

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restore ATP [adenosine-triphosphate], the body's immediate source of energy for muscle contraction. You only have so much ATP in your body and in a sprint, for instance, you burn it up. A 100-meter man can exhaust his supply, accelerating all the way. But a 400-meter man must pace himself or he will exhaust his supply too early in the race and slow down."

Ariel feels that there may be a nutritional way to stimulate ATP production naturally, to give an athlete more to work with. "Then there is no reason a sprinter can't go all out in a longer race."

Another exercise physiologist agrees that the field is in its infancy. "In talking about the limits of human performance—how good can you get?—it leaves the impression that we really know, and we really don't," says William J. Fink of the highly regarded Human Performance Laboratory at Ball State University in Muncie, Indiana. "In a sense, we lag behind the superb athlete and the superb coach because they are at a level of performance which we could not predict, but we can study them and find out or describe what's going on in their bodies and draw up some general conclusions that would be helpful for the average athlete. Sometimes we wonder whether we can create a champion," Fink muses. "When you get a group of world-class competitors together in any given sport, and test them, you find that they become indistinguishable from each other. So it becomes impossible to predict which one is going to be the winner. I still think we are a long way off from making champions."

So there is still no very sure answer to the questions posed by Bob Beamon's record-breaking jump in the 1968 Olympics. There have been efforts to discount Beamon's leap, put an asterisk next to it for "altitude." Indeed, a lower drag coefficient of the air in Mexico City may have accounted for some of his performance, as well as the fact that the city sits on a spot on the Earth that has a gravitational pull about one-sixth of one percent under what Beamon might have expected, say, in Los Angeles. Some analysts have factored in an environmental advantage of nearly nine inches, which still leaves a foot in the "mystical" category. "Beamon's performance was extraordinary," says Ernst Jokl. "But if it happened once, we can't ignore the possibility that it could happen again."

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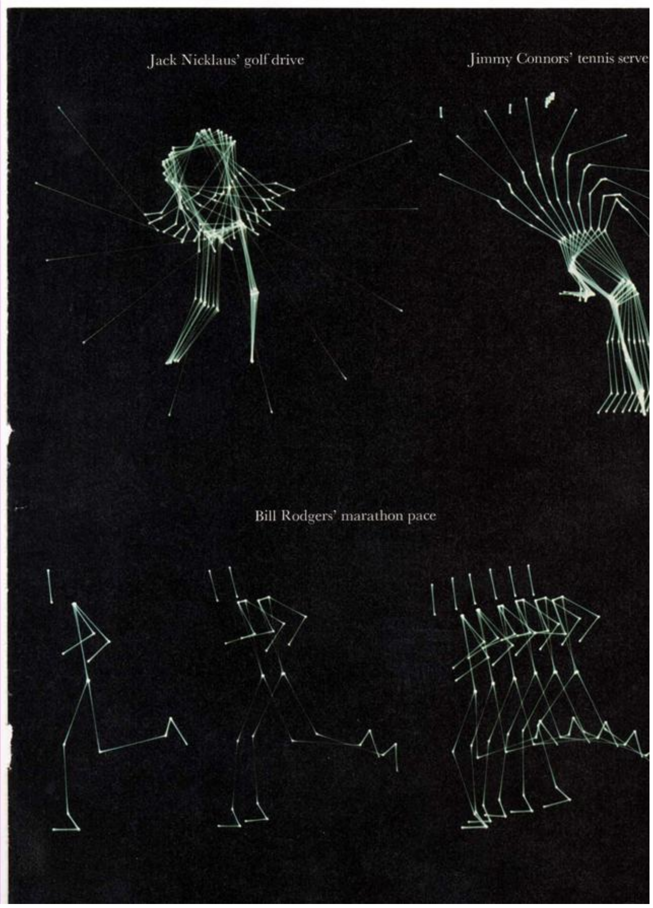

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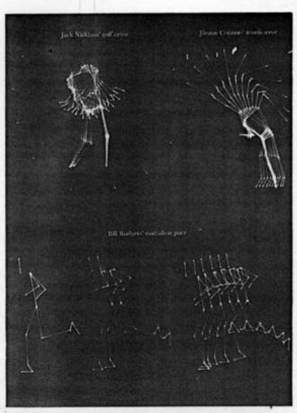

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