Why Winning Athletes Are Getting Bigger

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Pictured are Jordan Charles, left, and Adrian Bejan. Credit: Duke University Photography

While watching swimmers line up during the 2008 Olympic Games in Beijing, former Olympic swimmer and NBC Sports commentator Rowdy Gaines quipped that swimmers keep getting bigger, with the shortest one in the current race towering over the average spectator.

What may have been seen as an off-hand remark turns out to illustrate a trend in human development -- elite athletes are getting bigger and bigger.

What Gaines did not know was that a new theory by Duke University engineers has indeed showed that not only have Olympic swimmers and sprinters gotten bigger and faster over the past 100 years, but they have grown at a much faster rate than the normal population.

Futhermore, the researchers said, this pattern of growth can be predicted by the constructal theory, a Duke-inspired theory of design in nature that explains such diverse phenomena as river basin formation and the capillary structure of tree branches and roots.

In a new analysis, Jordan Charles, an engineering student who graduated this spring, collected the heights and weights of the fastest swimmers (100 meters) and sprinters (100 meters) for world record winners since 1900. He then correlated the size growth of these athletes with their winning times.

"The trends revealed by our analysis suggest that speed records will continue to be dominated by heavier and taller athletes," said Charles, who worked with senior author Adrian Bejan, engineering professor who came up with the constructal theory 13 years ago. The results of their analysis were published online in the Journal of Experimental Biology. "We believe that this is due to the constructal rules of animal locomotion and not the contemporary increase in the average size of humans."

Specifically, while the average human has gained about 1.9 inches in height since 1900, Charles' research showed that the fastest swimmers have grown 4.5 inches and the swiftest runners have grown 6.4 inches.

The theoretical rules of animal locomotion generally state that larger animals should move faster than smaller animals. In his contructal theory, Bejan linked all three forms of animal locomotion -- running, swimming and flying. Bejan argues that the three forms of locomotion involve two basic forces: lifting weight vertically and overcoming drag horizontally. Therefore, they can be described by the same mathematical formulas. (http://www.pratt.duke.edu/news/?id=1692)

Using these insights, the researchers can predict running speeds during the Greek or Roman empires, for example. In those days, obviously,

time was not kept.

"In antiquity, body weights were roughly 70 percent less than they are today," Charles said. "Using our theory, a 100-meter dash that is won in 13 seconds would have taken about 14 seconds back then."

Charles, a varsity breaststroke swimmer during his time at Duke, said this new way of looking at locomotion and size validates a particular practice in swim training, though for a different reason. Swimmers are urged by their coaches to raise their body as far as they can out of the water with each stroke as a means of increasing their speed.

"It was thought that the swimmer would experience less friction drag in the air than in the water," Charles said. "However, when the body is higher above the water, it falls faster and more forward when it hits the water. The larger wave that occurs is faster and propels the body forward. A larger swimmer would get a heightened effect. Right advice, wrong reason."

In an almost whimsical corollary, the authors suggest that if athletes of all sizes are to compete in these kinds of events, weight classes might be needed.

"In the future, the fastest athletes can be predicted to be heavier and taller," Bejan said. "If the winners' podium is to include athletes of all sizes, then speed competitions might have to be divided into weight categories. Larger athletes lift, push and punch harder than smaller athletes, and this led to the establishment of weight classes in certain sports, like boxing, wrestling or weight-lifting.

Source: Duke University (news : web)