

WORK-ENERGY-POWER

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A Little Deception Helps Push Athletes to the Limit

By GINA KOLATASEPT. 19, 2011



INTRODUCTION: Power = work/time, $P = W/t$, where cyclist work ends up as linear kinetic energy $\frac{1}{2} mv^2$, thus (dealing with the original power)
 $P_0 = (1/2 mv_0^2)/t$, with a power increase $P = [1/2 mv^2]/t$. eqs. A

QUESTIONS: (a) If P increases by 2 % ($P = 1.02 P_0$, eq.1), show that the velocity $v = 1.01 v_0$. **HINT:** Substitute eqs. A into eq. 1 and solve for v , note m & t constant
(b) Same question as (a), but show that if P increases 5% ($P = 1.05 P_0$ eq. 2) Show that the velocity increases by $\sim 2\%$, $v = 1.02 v_0$

HINT: Substitute eqs. A into eq. 2 and solve for v

The trained bicyclists thought they had ridden as fast as they possibly could. But Kevin Thompson, head of sport and [exercise science](#) at Northumbrian University in England, wondered if they could even faster. So, [in an unusual experiment](#), he tricked them. In their laboratory, Dr. Thompson and his assistant Mark Stone had had the cyclists pedal as hard as they could on a stationary bicycle for the equivalent of 4,000 meters, about 2.5 miles. After they had done this on several occasions, the cyclists thought they knew what their limits were. Then Dr. Thompson asked the cyclists to race against an avatar, a figure of a cyclist on a computer screen in front them. Each rider was shown two avatars. One was himself, moving along a virtual course at the rate he was actually pedaling the stationary bicycle. The other figure was moving at the pace of the cyclist's own best effort — or so the cyclists were told. In fact, the second avatar was programmed to ride faster than the cyclist ever had — **using 2 percent more power, which translates into a 1 percent increase in speed.** Told to race against what they thought was their own best time, the cyclists ended up matching their avatars on their virtual rides, going significantly faster than they ever had gone before. **While a 2 percent increase in power might seem small, it is enough to make a big difference in a competitive event that lasts four to five minutes, like cycling for 4,000 meters. At the elite level in sports, a 1 percent increase in speed can determine whether an athlete places in a race or comes in somewhere farther back in the pack.**

The improved times observed in his experiment, said Dr. Thompson, are “not just day-to-day variability, but a true change in performance.” And they give rise to some perplexing questions. What limits how fast a person can run or swim or cycle or row? Is it just the body — do fatigued muscles just give out at a certain point? Or is the limit set by a mysterious “central governor” in the brain, as Timothy Noakes, professor of exercise and sports science at the University of Cape Town in South Africa, has called it, that determines pacing and effort and, ultimately, performance? Until recently, exercise physiologists have mostly focused on the muscles, hearts and lungs of athletes, asking whether fatigue comes because the body has reached its limit. But athletes themselves have long insisted that mental factors are paramount. Roger Bannister, the first runner to break the four-minute mile, once said: “It is the brain, not the heart or lungs that is the critical organ. It's the brain.” Now researchers like Dr. Thompson are designing studies to learn more about the brain's influence over athletic performance. For example, Jo Corbett, a senior lecturer in applied exercise physiology at the University of Portsmouth in England, wondered how much competition can affect an athlete's speed. To find out, he asked cyclists to ride as hard and as fast as they could on a stationary bicycle for the equivalent of 2,000 meters. As he rode, each rider was shown an on-screen figure representing the cyclist riding the course. Then Dr. Corbett and his colleagues told each athlete that he would be racing against another rider hidden behind a screen. The researchers projected two figures on the screen, one the outline of the rider and the other the outline of the competitor. In fact, the competitor on the screen was a computer-generated image of the athlete himself in his own best attempt to ride those 2,000 meters.

Cyclists were told that the avatar would be going 2 percent faster or 5 percent faster than the cyclist had ever gone. The other group was deceived. Each cyclist was told to compete against an avatar that would be moving as fast as that athlete had in his best effort. Actually, the avatar was programmed to race 2 percent harder or 5 percent harder. (A 5 percent increase in power translates into a 2 percent increase in speed, Dr. Corbett said.)