Cloning for gold

News of Dolly, the cloned sheep, unleashed a torrent of speculation, including the idea that perhaps we could clone gold medal Olympic athletes. Would it work? Dolly was the sole success from 277 cell fusions,¹ so there is still room to question whether cloning will ever work reliably in mammals. However, now the psychological barrier has been broken, I would guess that cloning will quickly develop into a routine procedure in farm and laboratory animals, and that the technique will, in principle, be applicable to humans. So would cloning be a good way to produce Olympic champions?

Simply cloning an existing champion would not be very smart. True, we could subject the clone from the earliest age to an intensive training regimen, knowing that the effort would not be wasted on somebody whose potential was actually quite limited. But it would make much more sense to start off with a new combination of genes optimised for athletic prowess. Selective breeding could go a long way to achieve this. It has had limited success in animal athletics—the performance of racehorses, for example, has improved only little over many generations despite intensive selection.² However, humans have vastly more genetic diversity than bloodstock (most thoroughbreds derive from a mere 31 ancestors³), and if we want an illustration of the potential for selective human breeding, we should look at dogs rather than racehorses. When we compare Labradors with terriers we get a feel for just how far physique and temperament can be varied by selective breeding from a single ancestral species. I see no reason why we could not breed the human equivalent of greyhounds, who would easily outperform present day Olympic champions.

Once we had exhausted the possibilities of selective breeding, or become impatient with its slow progress, further improvement would depend on genetic manipulation. This would be used to introduce genetic variants that do

not exist in the present population. Normal embryonic development could be subverted for athletic ends—for example, skeletal muscles in mice lacking the transforming growth factor β gene are two to three times the size of those in normal mice.³ The results might be spectacular, but governments tend to frown severely on the germline genetic manipulation that would be needed to achieve this. As an alternative, we could alter normal physiological responses by somatic genetic manipulation. If we transfected somebody with an erythropoietin gene coupled with a tetracycline-inducible promoter, we might make people who would produce erythropoietin after a pre-race drink laced with tetracycline.⁴ No doubt the early attempts would fail, or even result in monsters, but this is an area supremely amenable to patient technical development, and in the long run we would surely get our genetically engineered super-champions.

The lesson is clear. Science has so far been applied to athletics in a very half-hearted way. Harnessing the full power of biotechnology could transform top level sport. Whether we would want to live with the results of doing that is, of course, another question entirely.

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- 1 Wilmut I, Schnieke AE, McWhir J, Kind AJ, Campbell KHS. Viable offspring derived from fetal and adult mammalian cells. *Nature* 1997;385:810–13.
- 2 Gaffney B, Cunningham EP. Estimation of genetic trend in racing performance of thoroughbred horses. *Nature* 1988;332:722–4.
- 3 McPherron AC, Lawler AM, Lee S-J. Regulation of skeletal muscle mass in mice by a new TGF- β superfamily member. *Nature* 1997;387:83–90.
- 4 Shockett P, Difilippantonio M, Hellman N, Schatz DG. A modified tetracycline-regulated system provides autoregulatory, inducible gene expression in cultured cells and transgenic mice. *Proc Natl Acad Sci USA* 1995;92:6522–6.