Big Heads

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Not only is there no apparent need for our big brains, but they are evolutionary big trouble. Big brains must be housed in large braincases—our heads. And if there was anything our evolving ancestors did not want, it was that their heads would grow big.

For a start, big heads make birth long and difficult. The birth canal of modern mothers is only just big enough for a baby's head. Even then, the baby must be turned on its side half way through to squeeze out. A human baby's head is uniquely round, which helps it "roll" on the way out, and its head and body are able to rotate. The mother's pelvis may have a small opening relative to the size of her child's head, but it is shaped optimally to aid its head-first birth. (Breech delivery—head last—in most cases requires a cesarean section.) The baby's cranium is incomplete at birth. Fontanelles, or gaps between its bones, allow the head to mold to shape of the pelvic opening. In fact, about one in six babies' heads end up getting noticeably changed in shape during delivery. The human ape is the only primate with such adaptations to aid birth delivery,[29] but it is still a difficult process; and human mothers can rarely give birth without assistance.

The problem, however, is not so much that human babies' heads are so large but that human mothers' pelvises must be so small. Our brains grow big mostly after birth, not before. Look at any picture of a newborn baby and his or her mother. Note the sizes of their heads.A newborn baby's head may be big for the birth canal, but it is still tiny—less than three-tenths the size of an adult's. Other apes are born with proportionately much bigger heads— slightly under half adult size.

But if a big-headed genie came out of the narrow aperture of a bottle to grant our ancestors one wish, it would be that their children's heads at birth would be even smaller. The problem is with bipedal running. Whereas most other primates and apes are built for tree climbing, we specialized in long-distance walking and running. That adaptation requires a narrow pelvis and thus a small birth canal, since the wider the pelvis, the less efficiently one can use one's legs.[30] Thus, the human infant's head is the biggest it can be and still be delivered by a mother able to run efficiently. Imagine what it would be like to run or walk with a pelvis wide enough to give birth to a baby with a head the size of a 1-year-old child's! As it is, the female pelvis handicaps women in athletics. World records in track events range from about 6.4 percent (100-meter dash) to 33 percent (pole vault) less for women than for men. This is not due to a general physical inferiority. Females compete on a par with males in athletic events that depend on upper body strength. Indeed, Gabriele Reinsch, the female discus record holder, has thrown 2.7 m farther than her male discus record rival.

Running is more important to our species than we may realize.[31] We take our legs for granted, but the stamina with which we can use them is a bit of a mystery. We are great long-distance runners; if need be, we can keep up a steady fast pace from dawn to dusk. Records in older editions of the *Guinness Book of Records* (before many of its interesting facts were removed to make it feel like less of a "textbook") show that people can run up to 188 miles (303 km) within 24 h and up to 621 miles (1000 km) in a single 136-h and 17-min stretch. And we can do this with heavy loads: Sedan chair bearers walked 30–35 mi (48–56 km) each day. Many non-Westerners, both men and women, are reported to carry "light" loads of 60 lbs (27.2 kg) for 25–40 mi (40–64 km) over rough landscapes. There is a report that one group of Chinese schoolgirls regularly walked 50 mi (80 km) daily.[32] In the manhunt for the outlaw (and Indian runner) Willie Boy in 1909, when horsemen came within 20 minutes of catching him he increased his stride into 5-foot paces. He carried on like this for 15 miles, and the horses were forced to stop and rest. He managed to outrun his pursuers for 500 miles.[33] In Mexico, Tarahumaran runners in kickball races covered 150–300 mi (150–200 km) over 1–2 days—more than six marathons. Imagine a chimp running even a few yards, and you can see how radically our legs have been turned into efficient long-distance running machines. No other primate—or any creature, for that matter—is so specialized for endurance.

If this is surprising to us, perhaps it is because most of us live such sedentary lives. Four in five Americans do less than the daily equivalent of half an hour of brisk walking, and one in four fail to do even the equivalent of half an hour's stroll.[34] We are dependent on our cars, not our feet. Not surprisingly, while our brains might be larger than would be expected for an animal of our size, our hearts are smaller—except for some regular marathon runners. Perhaps our relatively recent existence as nonexercisers blinds us to the power, efficiency, and uniqueness of our legs. We look back upon evolution as a story of increased brains, but then we are all acutely aware in our lives of the importance of sharp minds. This should not keep us from seeing that in the animal world, our running ability is unique, just as our mental capacities are.

Humans specialized in endurance running for a reason. To understand this, consider cheetahs and how they run. They are speed-sprinters that can outrun their prey in short dashes of 60 mph (100 km/h). But their physiology keeps them from doing it for long—just under 1 min and 0.6 mi (1 km). The maximal use of muscles increases their metabolic rate 50-fold. A human runner doing just over 5 minutes to the mile is burning energy at a rate of 1500 W (1.5 kJ/s). Movement takes up only 30 percent of that energy; the rest is turned into heat, which a cheetah's body has no effective way of removing as fast as it is made. That excess energy could kill it in the same way that an engine without a cooler will overheat if it is run for more than a few moments. If cheetahs kept running at 100 km/h they would cook themselves. Cheetahs avoid that fate by running only in short sprints, but that is not the only solution. Developing highly efficient means of getting rid of waste heat is another, but that requires a biological radiator. Though we do not take it as one of our most unusual features, we have turned the skin of our bodies into an efficient heat transfer system. Look at yourself—the human ape lost its fur and gained a cooling fluid. Every time you bathe, thank evolution for giving you a sweaty, naked body. Our sweat glands, when we are hot with exercise, secrete far more fluid than those of any other animal. A human marathon runner can sweat over 5 qt (5.5 L) in a run. Evaporating from bare skin, sweat can rid our bodies of 2450 kJ (583 kcal) of heat per liter and so keep a runner cool.[35] People doing heavy exercise may lose two and a half times as much fluid in sweat as in urine.

If you think about it, running for long periods is rather an odd skill. Other animals run to escape predators or to catch other animals. They must move quickly. What is emphatically not needed for them is a means of running for long durations over long distances. But that is the ability we have evolved. The answer, paradoxically, may be that such a running ability could be of advantage to an intelligent, bipedal predator. Standing high on two legs, humans could see farther than their prey and, if need be, climb up trees. Thus, however fast the animal they pursued might run, it could not keep dashing out of sight when persistently trailed by a clever, upright hunter built with the endurance to fatigue it, literally, to death.

This is not speculation, at least for modern people. Though it may not be widely known, people worldwide hunt animals by running them down over 1 or 2 days. Anthropologists record that in Africa, the San (Bushmen) run down wildebeest and zebras. In Australia, aborigines used to run down kangaroos. In ancient Syria, around 400 BC, the Greek writer Xenophon recalls starving soldiers running down bustards for food.[36] In the American Southwest, it has been claimed, the Navajo ran down one of the fastest of all animals, the pronghorn antelope.[37] This animal can go 53.1 mph (88.5 km/h).

While Lucy's legs were not quite like ours, Nariokotome boy's were. *Homo erectus* fossils cannot tell us of the miles they ran and walked and why they did so, but we can tell from the structure of their leg bones that Nariokotome boy and his kind exercised their legs well. Human evolution could not foresee the advantages of having genes for competing in the New York and London marathons, so what were they for?

We cannot deny that early humans hunted. Taï chimps show us that some smart apes would already have been doing that. Further, modern people show that endurance running enables people to hunt even the fastest of animals. On what grounds can we exclude our earliest ancestors' doing likewise? We would have to assume that they failed to exploit an opportunity for which their bodies were specially adapted. This argument, of course, is not evidence.We will never know for sure whether early people used their legs to outrun prey. However, our bodies are evidence that something critical to survival caused us to evolve endurance running. The most likely story is that Nariokotome boy's people were hunter-runners who depended on their legs to catch their prey.

Whatever use running had back then, it came at the cost of a narrower pelvis. Thus, our lower body and our enlarged cerebral hemispheres had been put on an evolutionary collision course, and our need to run should have won. Our brains thus arose not because of our legs but in spite of them. Evolution solved the big-brain/running conflict by delaying most of our brain growth until after birth to keep pelvises efficient for running. Thus, unlike other primates, our brains keep maturing for a year or more after birth. Our brains have a 21-month gestation, not a 9-month one.[38]

As noted, the first year of a human infant is one of total helplessness. After all, a human baby should really still be in the womb. It is so immature that its mother must constantly hold it and give it care. She is trapped into full-time caring for her newborn child to a degree not faced by any other primate mother, and she cannot be alone. She needs help and support from relatives and friends; such commitment was the price of big brains. Big brains would have arisen only in a situation in which a mother's extended family could "see" their own genes in her children and so be willing to support them. This is one reason for linking the rise of *Homo* so strongly with the above-discussed rise of family and symbolic kin networks. Only these would have given the needed help. And, of course, since these networks required recognition of male as well as female blood links, that would mean we must have been pair bonded and practicing social-sexual selection.

So those Lucy legs had to come before our brains. Some of the descendants of leggy apes would have been forced down the path of extreme infant dependency, pair bonding, and therefore social-sexual selection. That offered a tougher selection of brains than any made by nature:[39] the choices made by brains themselves. So it was not nature that selected the brains in your head. They were expanded by the social-sexual winnowing done by other brains. And our emerging language competence accelerated even more the runaway process.

Notes

29. Size of newborn heads: (Martin, 1982: 20–27).
30. Pelvic size and efficient bipedalism: (Day, 1992).
31. Running and our species: (Heinrich, 2001).
32. Ethnographic discussions of running and walking: (Devine, 1985; Nabokov and MacLean, 1980).
33. The hunt for Willie Boy: (Nabokov and MacLean, 1980: 17).
34. Lack of exercise by Americans: (cited in Pate, Pratt, Blair, et al., 1995).
35. Sweat cooling and evolution of running: (Heinrich, 2001; Porter, 1993).
36. Xenophon and running down bustards: (Xenophon: Anabasis, I, v).
37. Running and hunting down animals: (Carrier, 1984; Devine, 1985; Heinrich, 2001).
38. Twenty-one-month gestation: (Martin, 1982: 25–27).
39. One possibility we do not have room to discuss is whether big brains were needed to compensate for the handicap of inefficient "mindware."

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