Trainees can feel that their work is useless if it doesn't appear in a high-impact journal, even if it is tremendous work. Again, I feel extremely lucky that high-impact journal publication is not an overriding consideration in the NIH review system (at least in my fields).

Do you feel a push towards more applied science? How does that affect your own work? Honestly, I feel lucky to be in a research environment in which I can be valued for doing very basic, curiosity-based research, but where I am also welcome to try my hand at disease-based applications. I am in a basic-science-oriented department, but, as part of a medical school with lots of translational research, I rub shoulders with people going directly at cures. I will freely admit that, earlier in my career, I viewed the latter people with suspicion, as not really being pure scientists. Over the years, however, familiarity has not bred contempt but appreciation. Knowing more, I see that, by and large, translational researchers are incredible scientists, highly creative, and very interested in basic questions. I also had an interesting experience a few years ago that gave me perspective. At 4pm on a Tuesday afternoon, I gave a talk to a cancer group, telling them about some of our basic research with possible relevance to cancer. There were three clinicians in the front row who, within 10 minutes, were fast asleep. I felt indignant: "How dare they?!? Can't they see the value in this?" On the next Tuesday, I attended my first 'tumor board' where all of the various care-givers for that particular type of cancer (oncologists, surgeons, radiologists, genetic counselors, and others) get together weekly to go over every current patient and their progress. That meeting started at 6am and was very intense. Those three clinicians were at that meeting too and were centrally involved. It was very much an honor to be present at such a meeting, where I saw the depth of care that these people have for their patients. I realized that, from their perspective of trying to find ways to treat people who have cancer RIGHT NOW, my ramblings of somewhat remote possibilities for treatment might be difficult to get too invested in, especially since they had started work about 10 hours before I had given my talk the previous Tuesday. I learned a lesson: that we all come to things with our own perspective, and that all perspectives have validity.

Having said that, I do worry that fundamental, curiosity-based research is getting pushed out. There seems to be a tendency to think, after every big fundamental discovery or landmark, "Ok, that's the LAST thing basic research can give us. Now, we just need to put it all together and cure things." When I started my career in the late 1980s, there was a plethora of discoveries linking individual genes to diseases. Headlines tended to imply or overtly state that a cure was just around the corner. In many cases, we are still waiting for those cures. To me, discoveries such as the unfolded protein response (UPR) only get made in 'simple' model systems, and then get expanded out to mammals and disease implications when there are some clear targets. In the example of the UPR, imagine trying to find that first in mammals, which have three distinct branches of the response, rather than in budding yeast, which has only a single pathway, conserved with one of the mammalian pathways.

My personal model system is the cultured mammalian cell (fibroblasts or cancer cell lines). The criticism is "those cells aren't depicting anything remotely physiological, being grown on plastic for generations". My response is that I can do three or four experiments a week in this system, as opposed to one per week/month/year, depending on what one's 'physiological' system is (which generally has some compromises of its own). It's probably better that I focus on moving quickly on such a system, rather than dissipating effort and money by also working up a 'physiological' system. Somebody else who has those skills can do that.

DECLARATION OF INTERESTS

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Quick guide

Geladas

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What is a gelada? Gelada monkeys, known as the 'bleeding heart baboons' because of their distinctive red chest patches, are one of the most striking and charismatic primate species (Figure 1). Although they share a number of features allying them with baboons — most notably their ground-based lifestyle — they are not, in fact, true baboons of genus *Papio*; rather, they form their own genus, *Theropithecus*. The common name 'gelada baboon' is therefore a misnomer. Geladas are endemic to the highlands of Ethiopia, where they assemble in large herds on the high-altitude savannas and forage for roughly 50% of daylight hours. At night, they sleep on steep cliffsides. Geladas rarely climb trees — and when they try, they do so poorly — making them the most terrestrial primate apart from humans. As one of the most ecologically specialized primates, geladas consume a primarily graminoid-based diet (i.e. grasses and sedges).

What is the evolutionary history of* Theropithecus*? Geladas are the last remnants of a once-diverse and highly successful primate radiation. The rise and fall of the genus *Theropithecus* is one of the most fascinating stories in primate evolution. As savanna habitats expanded in Africa during the Pliocene and Pleistocene, numerous species of *Theropithecus* became widespread across the continent, even venturing into Europe and Asia. Notably, there is no fossil record for geladas, but there is an abundant fossil record for the extinct species. Some species, such as *T. oswaldi*, were two to three times the size of geladas. These other species went extinct roughly 50,000 years ago, which is likely to have been a result of climate change and predation by our hominin ancestors. The gelada is the smallest member of the genus, but in most respects, it is morphologically similar to its extinct relatives, making

Figure 1. Geladas.
Geladas, known as the 'bleeding-heart monkey', are notable for the striking secondary sexual characteristics in males such as long canines, a furry cape, and a red chest patch (left). The basic unit of gelada society is the one-male unit, consisting of one harem male and several adult females (center). Geladas are unique among mammals in their evolutionary specialization to harvest graminoid material with their hands (right; image used with permission by Jeffrey Kerby).

it a good model for reconstructing the behavior and ecology of its fossil relatives.

Are there multiple subspecies of gelada? The gelada monkey has two relatively well-known subspecies: *Theropithecus gelada gelada* and *Theropithecus gelada obscurus*, both of which live in the northwestern Rift Valley of Ethiopia. However, in the late 1980s, several new gelada populations were found in the Arsi region of the southeastern Rift Valley, Ethiopia. Genetic analysis suggests these populations represent a third subspecies (*Theropithecus gelada arsi*). At present, little is known about how the three subspecies differ in behavior and biological adaptation.

What is unique about the gelada diet? Geladas have evolved a host of morphological, physiological, and behavioral adaptations to cope with their graminoid-based diet. Their molar teeth are tall and rugose, serving to shear tough foods and resist wear. Their hands have a high opposability index — second only to humans — that facilitates the precise and rapid plucking of grasses and herbs and roots. When feeding, geladas adopt a 'shuffling' style of locomotion that frees both hands to forage simultaneously. Geladas do not have specialized stomachs — unlike leaf-eating colobine monkeys — for digesting a relatively poor-quality diet. Instead, geladas are hindgut fermenters, relying on particle size reduction and the activity of the gut microbiome to help digest their food. In this respect, they are like the horses of the primate world.

Are geladas ecological specialists? Geladas are widely considered ecological specialists. Early studies found that geladas spend roughly 90% of feeding time on aboveground graminoids during the wet season, with a shift to underground storage organs during the dry season. However, these early studies were conducted in environments with high levels of human disturbance, particularly domestic animal grazing. More recent studies, conducted at field sites with minimal anthropogenic disturbance, offer a more complex picture of gelada dietary ecology. The gelada diet at such sites is surprisingly diverse, consisting of >70 species of plant, in addition to invertebrate and vertebrate prey. Herbs are also more common in the diet than previously recognized. Moreover, during the dry season geladas exhibit a preference for aboveground vegetation when it is available, rather than underground storage organs. This suggests that the traditional emphasis on underground storage organs in gelada diets may be a product of anthropogenic influence.

What are the key features of gelada social organization? The core social unit of gelada society is the one-male unit, consisting of an adult harem male and two to ten females, along with juveniles and infants. The male has sole mating access to these females, though extra-pair copulations do occur. As female-bonded papionins, females stay in their natal groups. Juvenile males disperse around the age of six and live in all-male units for several years. As polygynous primates, geladas experience high levels of male–male competition, resulting in pronounced sexual dimorphism in canine size and body mass (male: ~19 kg; female: ~11 kg). In such a social system, infanticide risk is high for females. Pregnant female geladas have been observed to spontaneously terminate their pregnancies ('Bruce effect') following arrival of a new harem male. Because any newborn infants would be likely to be lost to infanticide, this is an adaptive behavior that salvages the reproductive interests of the female.

What kind of society do geladas live in? Geladas live in multi-level societies that exhibit fission–fusion dynamics in the context of a hierarchically-nested social organization. As humans also exhibit multi-tiered social organization, studying the function of multi-level sociality in geladas may shed light on human social evolution. Beyond the one-male unit, 'teams' consist of two (or more) one-male units that tend to stay together more frequently than other units, and 'bands' consist of one-male units that share a common home range. Finally, there is the 'herd', which can reach up to 1200 individuals. The herd is not a social unit *per se*, but rather a temporary aggregation. Members of different one-male units rarely interact with one another but exhibit high social tolerance.

What do geladas tell us about human evolution? Early primate researchers focused on geladas' ecological and social adaptations for coping with savanna life, using them as 'referential models' for human evolution. The prominent 'seed-eater' hypothesis of Clifford Jolly suggested that the distinctive traits of geladas noted above — the hands, teeth and upright feeding posture — parallel the changes observed in our own hominin lineage. More recently, researchers have capitalized on the rich fossil record for extinct theropiths to shed light on the paleoenvironmental context of human evolution. Isotope analysis indicates that some extinct hominins — such as *Paranthropus boisei*, known as 'Nutcracker Man' — may have consumed graminoid tissues, feeding alongside ancient theropiths. Finally, the remarkable vocal capacities of geladas have drawn attention for several hundred years. The 4th-century AD Christian historian Philostorgius wrote: "Even the voice is similar to the human, except that it is not articulate, but is like meaningless mutterings uttered rapidly in rage or fear." More recently, researchers have used geladas as a model to explore links between vocal complexity and social complexity (https://www.youtube.com/watch?v=JbdQumeqo50).

What does the future hold for geladas? Geladas are currently listed as of 'Least Concern' by the IUCN Red List. In the 1970s, gelada populations were thought to number ~700,000 individuals. But there is reason to suspect the conservation prospects of geladas should be revised. The densely populated Ethiopian highlands — known as the 'water towers of Ethiopia' for their hydrological ecosystem services — are extremely rugged, and remaining gelada populations are increasingly shrinking and isolated in Afroalpine 'islands in the sky' as a result of the increasing pressure of habitat loss and domestic grazing pressure. Under this scenario, the potential demographic collapse of gelada populations may not be reflected in current population numbers and distribution. This is especially true of the Arsi gelada population, which is probably highly threatened due to its restricted distribution and isolation. Systematic surveys of gelada populations across Ethiopia, in addition to further work on gelada–human conflict, are urgently needed, especially in light of recent political instability across Ethiopia. This will aid in developing and enacting conservation plans to ensure this charming primate will be around for future generations to come.

Where can I find out more?

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DECLARATION OF INTERESTS

The authors declare no competing interests.

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Quick guide

Cassava

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What is cassava? Cassava *(Manihot esculenta* Cranz*)*, also known as manioc or yuca, is a tropical perennial shrub in the Euphorbiaceae. Cassava is widely cultivated as a food crop due to its starchy, tuberous roots, and to a lesser extent, leaves. Cassava was domesticated from its wild progenitor (*Manihot esculenta* ssp. *flabellifolia*) in South and Central America over 6,000 years ago. Between the 16th and 19th centuries, cassava was introduced by European explorers to Africa, Asia, and more recently to the Pacific. There is evidence for widespread hybridisation and introgression with related species (e.g., with tree cassava, *Manihot glaziovii* Allem). Cassava is an important food security crop for over 800 million people worldwide, and a staple for 40% of people living in sub-Saharan Africa. It is estimated that it is eaten by around one billion people every day, placing it among the top ten globally produced crops.

Why is cassava so widely cultivated? Cassava is widely cultivated due to its tolerance to drought and heat, ease of propagation, and its ability to grow on poor soils with minimal cultivation (Figure 1). Adaptations for conserving water include the development of deep root systems, closing stomata or shedding leaves to prevent water loss through leaf transpiration, and the ability to regrow from the tuberous roots. Cassava is also fast-growing, high yielding, and easily propagated from stem cuttings. Furthermore, mature tubers (technically, these are tuberous roots) can remain in the ground for up to three years, providing important food reserves in times of food insecurity. These characteristics have made cassava an invaluable source of nutrition for regions such as sub-Saharan Africa, which face challenges of water deficit and limited arable land, especially