Stress in the Wild

Studies of free-ranging baboons in an African reserve are helping to explain why human beings can differ in their vulnerability to stress-related diseases

by Robert M. Sapolsky

The year was 1936. Hans Selye, a young physician just starting off in research at McGill University in Montreal, had a major problem. He had been injecting rats daily with a chemical extract to determine the extract's effects and had identified consistent changes in the animals: peptic ulcers, atrophy of immune-system tissues and enlargement of the adrenal glands. To his surprise, however, the rats in the control group, which had been injected with saline solution alone, showed identical changes.

Most scientists would have thrown up their hands at this paradox. Instead Selye focused on what the two groups had in common: the repeated injections. He wondered if the trio of changes he had identified was actually a generalized physiological response to unpleasantness per se.

He then tested that idea and found the same three effects regardless of whether rats were made too hot or too cold or were exposed to pathogens, toxins or loud noises. Selye borrowed a term from engineering to describe the body's nonspecific response to an insult. What the rats were undergoing, he decided, was stress. Thus, the field of stress physiology was born.

Since 1936 important details have been added to Selye's initial characterization of the stress response, which is now known to involve the secretion of perhaps a dozen hormones and the inhibition of various others. Many studies have also demonstrated that chronic activation of the stress response can impair health. Moreover, some people seem to be more vulnerable to stress-related disorders than others. What accounts for the difference in susceptibility? Is it simply that some people are exposed to more stress in their daily lives, or do people actually differ in how their bodies respond to stress?

I am approaching these questions in an unusual way—by studying stress in free-ranging baboons. My ongoing research program has added strong support to a growing body of work suggesting that people's psychological and social characteristics (for example, their emotional makeup, personality and position in society) can profoundly influence their physiological response to stress.

Although chronic activation of the stress response can be harmful, few individuals could live for very long if their bodies were unable to invoke it. In fact, the stress response enables an organism to withstand immediate threats to its homeostatic balance, or physiological equilibrium. The response can be triggered by an actual insult (a physical stressor), such as extreme cold or the attack of a predator, or by the mere expectation (a psychological stressor) that an insult is about to be delivered.

In essence, the stress response prepares the body for "fight or flight." Glucose, the body's primary source of energy, is mobilized from storage sites. Blood, which transports glucose and oxygen, is diverted from organs that are not essential for physical exertion, such as the skin and intestines, and is delivered quickly to organs that are crucial—namely, the heart, the skeletal muscles and the brain. The shift in blood flow is accomplished in part by constricting some blood vessels, dilating others and increasing the heart rate. Meanwhile cognition is sharpened (perhaps to facilitate the processing of information), and the perception of pain is blunted. And physiological activities that are not of immediate benefit are deferred; hence, growth, reproduction, inflammation and digestion—all of which are expensive, optimistic processes—are inhibited.

Chronic activation of the stress response can damage health by various means. If glucose is constantly mobilized instead of being stored, then healthy tissues atrophy, and fatigue sets in. With enough time, the cardiovascular changes promote hypertension, which in turn can damage the heart, the blood vessels and the kidneys. Moreover, when constructive processes are deferred indefinitely, the body pays a price in the form of impaired growth and tissue repair, reduced fertility and, as Selye's results suggested, diminished immune function and increased susceptibility to peptic ulcers.

As new links between stress and disease emerge, it sometimes seems miraculous that anyone can function in the modern world without being incapacitated by stress. Still, most people do just fine. The question of why this is the case has been addressed from several perspectives. Some investigators study the effects of stress on human beings directly. For example, people who have classic, hard-driving, Type A personalities have been found to be at increased risk for hypertension and heart disease. Yet the physiological events translating personality traits into diseases that take years to develop are difficult to trace in human beings, who, after all, have complex emotional lives and cannot be caged in laboratories for controlled, long-term study.

Taking a different approach, some

ROBERT M. SAPOLSKY is assistant professor of biology at Stanford University, assistant professor of neurosciences at the Stanford University School of Medicine and a research associate at the Institute of Primate Research of the National Museums of Kenya. He earned a bachelor's degree from Harvard College in 1978 and a Ph.D. in neuroendocrinology from Rockefeller University in 1984. He completed postdoctoral studies in 1987—the year he joined the Stanford faculty and was also awarded a MacArthur fellowship. When Sapolsky is not engaged in fieldwork, he studies how stress can damage brain cells and how the brain regulates the release of stress hormones.

investigators study such subjects as laboratory rats. For instance, in the 1960's Jay M. Weiss, then at Rockefeller University, showed that a sense of control or predictability can strongly influence an animal's physiology. For example, rats who receive a warning before they are exposed to an electric shock have a lesser stress response and less pathology in comparison with subjects who receive the same sequence of shocks but without warning. Yet the psychology of human beings is (hopefully) more complicated than that of rats, and so the subtlety of the psychological variables that can be studied in such animals is limited.

Captive primates are a reasonable alternative to both human and rodent subjects, but captivity, which is stressful in itself, can distort an animal's behavior and baseline measures of physiological functioning. Thus, it may compromise the applicability of any findings to noncaptive populations.

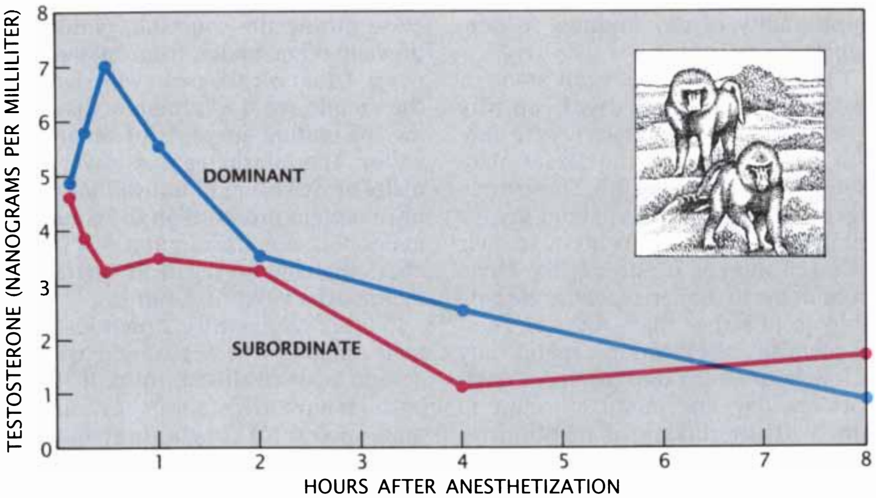
I have tried to circumvent some of the problems associated with captivity by studying olive baboons (*Papio anubis*) living freely in the Masai Mara National Reserve in Kenya. These intelligent animals are good stand-ins for human subjects in part because their primary sources of stress, like those of humans in modern society, are psychological rather than physical. Food is plentiful; the baboons spend only a few hours each day feeding. Predators are few, and infant mortality is low. With the luxury of plentiful resources and free time, the animals can devote themselves to distressing one another.

I study the males, who are quite adept at that activity. Violence itself is actually rare, but the hint of violence is ever present. Consider what can happen to a suitor who forms an association with a female in "heat," staying close during the courtship period to prevent other males from taking his place. Often a rival male will shadow the couple for days, thereby disrupting the mating attempts of the initial suitor. The interloper may never formally provoke a fight but will inexorably maintain pressure on the courting male. It is not uncommon for these chess matches to result in surrender by the exhausted first suitor.

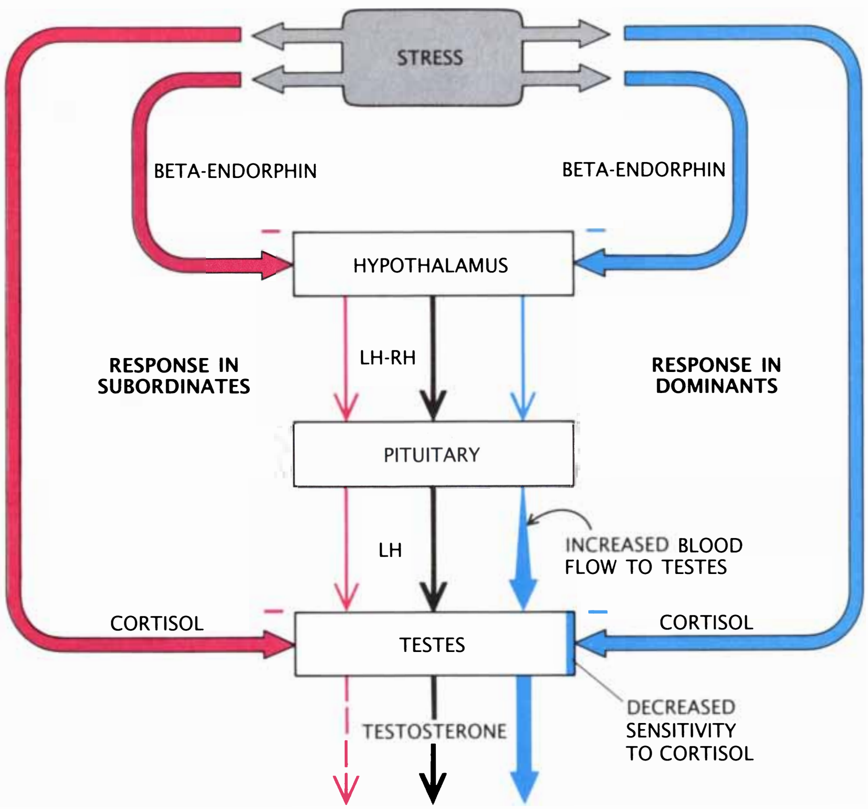
In other competitive situations, one male might form a coalition with a second male against a third. If these partnerships are stable, they can be quite successful. Long-term stability is rare, however. After spending hours establishing a coalition, a baboon may find himself abandoned in the middle of a fight or, worse, double-teamed, as his erstwhile colleague opportunistically switches sides.

Some animals are victimized more than others. The males form dominance hierarchies, and the lives of

MALE OLIVE BABOON (*Papio anubis*) in the Masai Mara National Reserve in Kenya struggled to kill a gazelle for food (*left*) only to have his meal ended prematurely when a more dominant, or higher-ranking, male (approaching from behind) expressed interest in the bounty (*right*). Presumably frightened by the interloper, the first baboon retreated quickly. Such scenes are common in the reserve; olive baboons, like human beings, are adept at stressing one another. The author has discovered that dominant males as a group generally have a different physiological response to stress than do subordinate males.



AVERAGE TESTOSTERONE LEVELS in dominant and subordinate male baboons are essentially equal when the animals are at rest but typically diverge strikingly when the animals are exposed to an identical stressor—in this case, anesthesia. The levels of the subordinate males (*red*) plummet immediately, whereas those of the dominant males (*blue*) rise sharply at first and remain elevated for approximately an hour.



CAUSES of differing testosterone levels in subordinate and dominant males during stress have been identified. When an animal rests, testosterone is released as the last step in a hormonal cascade (*black arrows*) beginning at the hypothalamus in the brain. The hypothalamus secretes luteinizing hormone-releasing hormone (LH-RH), causing the pituitary gland to release luteinizing hormone (LH), which in turn stimulates the testes to secrete testosterone. Stress triggers the release of beta-endorphin, an opiumlike substance, in both subordinate (*red arrows*) and dominant (*blue arrows*) males; this substance then inhibits (*minus signs*) the secretion of LH-RH, and thus LH, in both groups. In subordinate males testosterone levels fall because of the LH decline and because of the secretion of the hormone cortisol (hydrocortisone) during stress; cortisol tends to diminish the testes' responsiveness to LH. Testosterone levels in dominant males rise because the testes become relatively insensitive to cortisol and because the flow of blood to the testes increases; for a time, this increased flow actually increases the amount of LH that is received.

the animals who occupy the most subordinate positions are filled with a stressful lack of both control and predictability. Dominant males have easier access to food, to safe resting places and to shady spots at midday. They often have easier access to sexual partners and will be groomed more readily by other baboons. In contrast, subordinate males may laboriously dig tubers from the ground only to have the food nonchalantly seized by dominant males. Dominant males who lose a fight often seek a subordinate on whom to vent frustration, and they are likely to displace aggression onto the innocent bystander without warning.

Thus, the olive baboons occupy a social landscape of Machiavellian dimensions. Alliances shift unpredictably; threats range from days of harassment to sudden bursts of violence, and a baboon bent on avoiding the turmoil may still fall victim to another animal's problem.

When I began studying the olive baboons in 1978, one of my first tasks was to determine whether two baboons exposed to an identical stressor can in fact have different physiological responses. When I considered that a male's rank profoundly influences what he does in a day and how he is treated by others, I began to wonder whether rank might somehow also affect how the males respond to stress. Would the physiological response of dominant and subordinate males differ?

It turns out that the stress response does differ in the two groups. I have therefore explored the nature of these differences in some detail, along with their possible causes.

Every year I spend three months in Kenya, where I study the baboons according to a standard routine, usually with the help of a Kenyan assistant, Richard Kones. We begin by determining the males' social rank that season, which essentially involves evaluating how often the animals get what they want. For instance, we rate the animals according to whether they win most of their fights, are more often the harasser rather than the harassed, and are able to supplant another male (who might be, say, resting in a desirable spot, feeding or being groomed). I consider males in the top half of the hierarchy to be dominant and those in the bottom half, subordinate.

Once the males' social positions are known, I assess their baseline hormone levels and measure their metabolic responses to a physical stressor:

anesthesia. I anesthetize the animals by "darting" them with a syringe shot from a blowgun. Before the animals lose consciousness, they become momentarily disoriented, which seems to trigger the stress response. The anesthesia not only stresses the animals, it also makes it possible to obtain repeated blood samples over the course of the day and thus to track changes in the animals' hormone levels.

In carrying out the darting I have to adhere to many constraints. The baboons must all be injected at the same time of day, to control for rhythmic fluctuations in hormone levels. No animal can be darted if he has been injured or sick recently or if he has mated or had a major fight; such experiences will distort resting, or baseline, values of hormones. For the same reason, I have to be sure the animals have not eaten before they are anesthetized. Animals must not sense they are being stalked, or the data might be confounded by anticipatory stress. Finally, an initial blood sample (which establishes the baseline levels of the hormones to be studied) must be obtained within a few minutes after anesthesia sets in; if too much time elapses, the levels of the hormones of interest will have changed.

With this approach I have found that when the dominance hierarchy is stable (as it usually is), the workings of nearly every physiological system I have examined differ between the dominant and subordinate males. It also turns out that the physiological profile of the subordinate animals is closer to the type that is thought to predispose humans to stress-related disease.

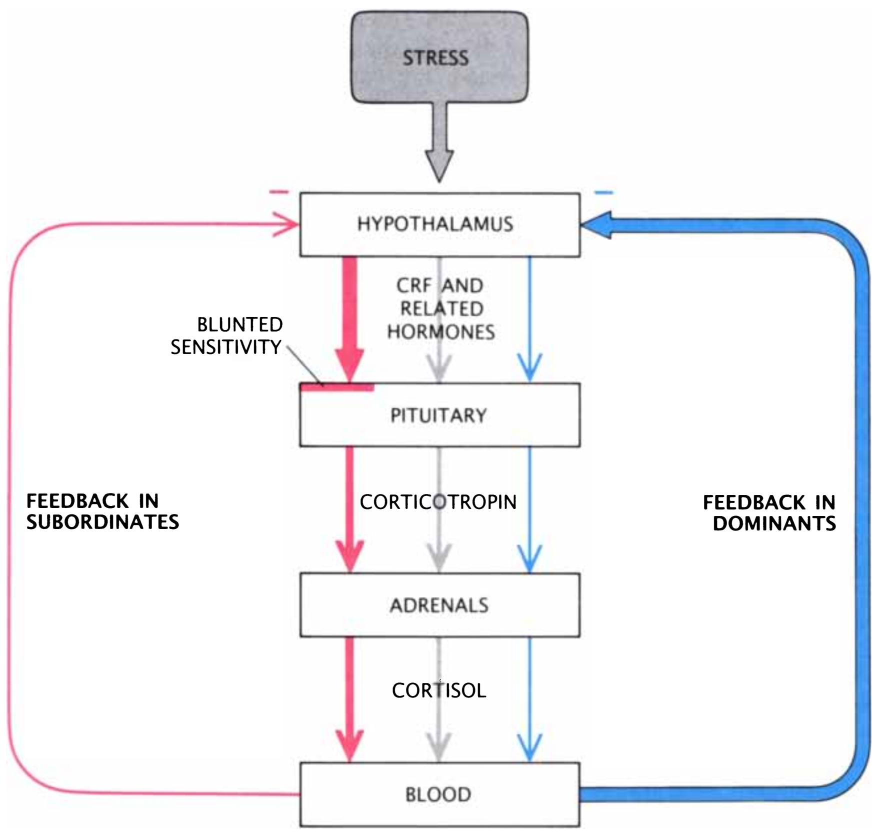
The hormonal system that controls the secretion of testosterone (the principal reproductive hormone in males) offers a good example of how the stress response differs between dominant and subordinate olive baboons. Although the average resting levels of testosterone are essentially the same in both groups, the levels diverge markedly when the animals are stressed.

Testosterone is normally released as the final step in a cascade of hormone secretion that begins at the brain. There, the hypothalamus releases a substance known as luteinizing hormone-releasing hormone, which stimulates the pituitary gland to release luteinizing hormone. This hormone, in turn, triggers the testicular release of testosterone.

In both dominant and subordinate baboons, as in human beings and rats, testosterone levels plummet in response to stress. Yet the similarity between dominant and subordinate males ends there. After the baboons are darted, the testosterone levels of subordinate males decline promptly, whereas those of dominant males actually rise and remain elevated for perhaps an hour before declining.

Theoretically, the rise in testosterone could give dominant males a survival and social advantage, because the hormone increases the rate at which glucose reaches the muscles. Such changes would be expected to help dominant baboons withstand a physical challenge. (Testosterone also regulates sexual behavior and aggression, but the magnitude and duration of the testosterone increase found in dominant males during stress would not be enough to improve sexual performance or to make dominant males more aggressive than others.)

What causes testosterone levels to decline during stress, and by what mechanism are the levels elevated for a time in dominant males? I have discovered that the decline is driven in part by the stress-induced secretion of the opiumlike substance beta-endorphin, a pain suppressor that is best known for causing the so-called runner's high. Beta-endorphin, which is secreted by several organs, suppresses the hypothalamic secretion of luteinizing hormone-releasing hormone, which in turn suppresses the pituitary secretion of luteinizing hormone, leading to a decline in the



MECHANISM regulating the release of cortisol is disrupted in subordinate males, which helps explain the finding that, under normal circumstances, the mean basal cortisol levels of subordinate males are higher than those of dominant males. In both groups of animals the release of cortisol increases in response to stress (*gray arrows*): the hypothalamus secretes corticotropin-releasing factor (CRF) and related hormones, and these stimulate the pituitary gland to release corticotropin, which causes the adrenal glands to release cortisol into the blood. In dominant males (*blue arrows*) the hypothalamus receives accurate feedback from the blood, so that the brain is informed soon after a threshold level of cortisol is reached; the brain then inhibits the secretion of CRF and its relatives, leading to a decline in cortisol release. In subordinate baboons (*red arrows*) the feedback signal is weak, and so the brain is informed that cortisol levels are low even when they are actually high. Consequently, the hypothalamus markedly increases its secretion of CRF and related hormones. The pituitary of subordinates is somewhat insensitive to such substances, but the large amounts reaching the pituitary nonetheless trigger an increase in the secretion of corticotropin, which then leads to the chronic hypersecretion of cortisol.

amount of luteinizing hormone that reaches the testes. I determined that beta-endorphin accounts for the decline in luteinizing hormone by administering a drug to the baboons that blocks the access of the opioid to its receptors in the hypothalamus. When the activity of beta-endorphin was thus blocked, there was no stress-induced lowering of the levels of luteinizing hormone.

Another cause of the decline in testosterone levels is a decrease in the sensitivity of the testes to luteinizing hormone. This change is caused by the hormone cortisol, or hydrocortisone, which is released in quantity by the adrenal glands during stress.

The initial rise in testosterone levels after darting in dominant males cannot be explained by changes in the activity of either the brain or the pituitary gland, because the levels of luteinizing hormone released by the pituitary decline equally in high- and low-ranking males. Nor are cortisol levels involved; they are the same during stress in both groups. The explanation, then, must lie elsewhere.

I have found that a two-part mechanism seems to be responsible. In one part the testes of the dominant males somehow become less sensitive to the testosterone-inhibiting effects of cortisol. Yet, if decreased sensitivity to cortisol were the only mechanism operating, it would merely slow the decline of testosterone levels but would not lead to their elevation.

The rise itself probably results from the stress-induced release by the sympathetic nervous system of what are called catecholamines, such as adrenaline and noradrenaline, which affect blood flow. For unknown reasons, the testicular vascular system of dominant males is particularly sensitive to the dilating effects of the catecholamines, and so the testes of dominant males probably receive more blood during stress than do those of subordinate males. Hence, although the output of luteinizing hormone from the pituitary gland declines in both groups, any luteinizing hormone in the blood is probably delivered faster to the testes of dominant males. Such enhanced delivery would lead to a temporary increase in the amount of luteinizing hormone reaching the testes and so to an increase in the testicular output of testosterone.

My work has also identified rank-associated differences in the organ system responsible for increasing the release of cortisol into the blood during stress. The secretion of cortisol, like that of testosterone, is the final step in a cascade of hormone secretion that begins in the brain. In this case, when the animal is stressed, the hypothalamus steps up its secretion of corticotropin-releasing factor and related hormones. These hormones cause the pituitary gland to release adrenocorticotropic hormone, also known as corticotropin. Corticotropin, in turn, stimulates the adrenal glands to release cortisol.

BETRAYAL BY A COMRADE during a fight is a typical stressor for baboons. The males often form coalitions for battle but never know if a partner is reliable. In one typical

Cortisol is responsible for much of the double-edged quality of the stress response. In the short run it mobilizes energy, but its chronic overproduction contributes to muscle wastage, hypertension and impaired immunity and fertility. Clearly, then, cortisol should be secreted heavily in response to a truly threatening situation but should be kept in check at other times. This is precisely what occurs in dominant males. Their resting levels of cortisol are lower than those of subordinate males yet will rise faster when a major stressor does come; exactly how this speedier rise is accomplished is not understood.

I determined the cause of the higher basal cortisol levels in subordinate males by separately studying each part of the cascade that leads to the hormone's release and clearance from the blood. Working backward from the blood to the brain, I determined that the cortisol is cleared from the blood of subordinate and dominant males at the same rate. Therefore, the high cortisol levels of subordinates must stem from the excess secretion of cortisol by the adrenal glands.

This excess cortisol secretion could result from an increased sensitivity of the adrenal glands to corticotropin, excess secretion of corticotropin by the pituitary gland, or both. I found that the adrenal glands of subordinate males are not more sensitive; therefore, they must be exposed to more corticotropin.

The overproduction of corticotropin could similarly be caused by enhanced sensitivity of the pituitary gland to corticotropin-releasing factor and its relatives, excess secretion of these substances by the brain, or both. I found that the pituitary's sensitivity is actually diminished in subordinate animals. Thus, the brain probably hypersecretes corticotropin-releasing factor and its relatives, ultimately giving rise to high cortisol levels in the blood. The release of hormones by the hypothalamus cannot be measured noninvasively, but my conclusion is supported by the fact that Philip W. Gold and his colleagues at the National Institute of Mental Health came to essentially the same conclusion when they traced the causes of elevated basal cortisol levels in humans who were depressed.

Why would the brains of subordinate male baboons trigger excess cortisol release when the animals are at rest? No doubt part of the answer has to do with the animals' stressful lives, which would lead to frequent stimulation of cortisol secretion. In addition, the animals have difficulty regulating the system responsible for the secretion of cortisol.

In any chain of command, the chief needs feedback, an indication that the commands have been obeyed. In this system, the levels of cortisol—the final hormone secreted in the stress-response cascade—must be sensed by the brain. The brain should continue to evoke cortisol secretion until some threshold level of hormone has been reached, and it should inhibit secretion when the threshold is met. I wondered whether the brains of subordinates sense blood cortisol levels appropriately and found they do not.

This discovery was made by administering a synthetic version of cortisol called dexamethasone to a number of baboons. In dominant male baboons, as in most people, the brain senses the

scene two pairs of animals face off (*left*). As the fight begins, one animal abandons his partner, who is left to cope alone (*center*). Then a member of the opposing pair also withdraws, so that only two hapless combatants remain (*right*) in the end.

presence of dexamethasone and responds by curtailing the secretion first of corticotropin-releasing factor, then of corticotropin and then of cortisol. In contrast, subordinate baboons (and depressed people) are dexamethasone-resistant, that is, their brains are insensitive to the shut-off signal. As a result, cortisol production continues unchecked.

Whether subordinate males are in fact being harmed by their high basal cortisol levels remains to be seen, but certain danger signs are already evident. For instance, Glen E. Mott of the University of Texas at San Antonio and I found evidence suggesting that subordinate males may be at higher risk for atherosclerosis and thus for heart disease. In comparison with dominant male baboons, subordinates have less circulating HDL cholesterol, which is the "good" kind that helps prevent atherosclerosis. This difference was not attributable to diet, levels of activity, body weight, genetics or testosterone levels but was attributable to cortisol. We found that the higher a baboon's basal cortisol values are, the lower its levels of HDL cholesterol will be. Moreover, laboratory studies have shown that cortisol can suppress the production of HDL cholesterol.

Cortisol is known to suppress immune function during stress, and so I also compared a measure of such function in the two groups of baboons. Indeed, subordinate males have fewer circulating lymphocytes (white blood cells) than do dominant males. Although the HDL cholesterol and lymphocyte signs are ominous, the determination of whether subordinate baboons are at greater risk for heart attacks and infections can only be made by studying the same animals throughout their lives. Complicating such analyses is the fact that social rank can change over time: dominant males wreaking havoc today may have been cringing subordinates when I first met them in 1978.

Even considering this caveat, I initially interpreted my data to suggest that the physiology of subordinate males predisposes them to stress-related disease. Rank is physiological destiny, the data seemed to say, and the other physiological systems I have studied in these males gave the same impression.

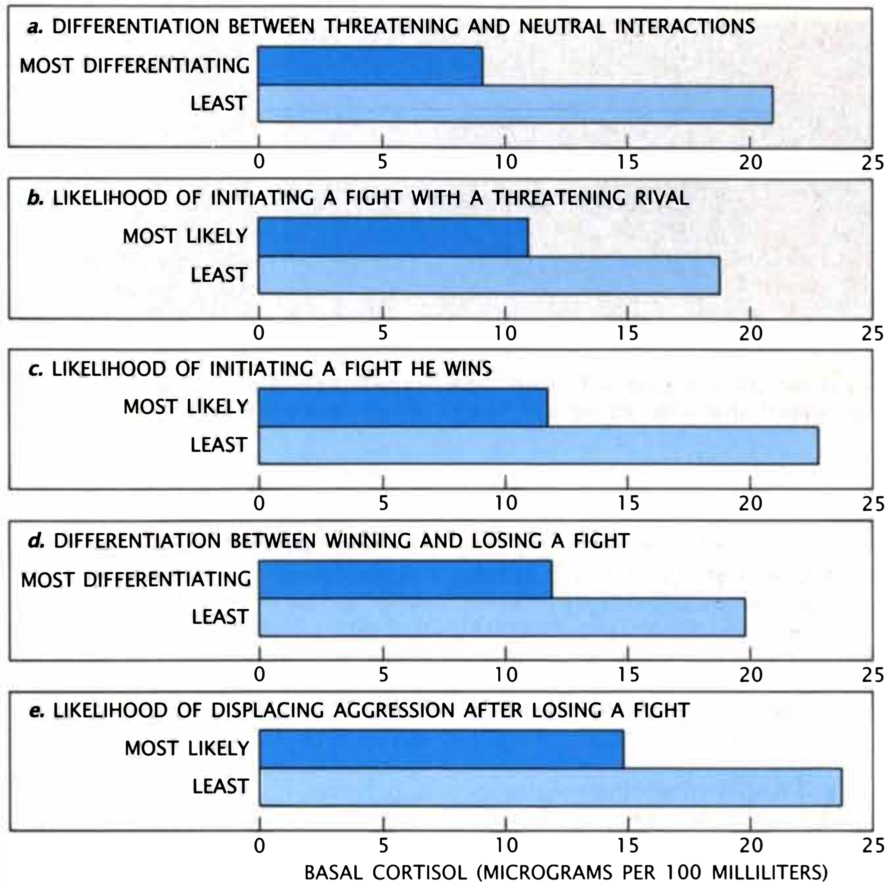
What aspect of rank might influence physiology the most? My own observations and others' studies of captive animals led me to suspect that the psychological benefits of having a high rank could be particularly important. My first hint that psychological factors might be crucial came in 1981, when the dominance hierarchy of the olive baboons became unstable. The highest-ranking, or alpha, male in my study group had passed his prime and had no heir-apparent; usually there is an obvious second-ranking animal exerting pressure on the alpha male to step aside. Instead, in this year, half a dozen young males formed a coalition to oust the alpha male. In the aftermath of the successful coup, however, the coalition disintegrated promptly. Any of these males dominated the rest of the troop's males, but among themselves, no clear hierarchy emerged. Instead months of instability ensued: coalitions formed among subgroups of dominant males and then fell apart; the amount of aggression and the number of interactions meant to test dominance increased; and ranks shifted constantly.

During this turmoil, the advantageous physiological correlates of dominance seen in other years disappeared. In contrast to males who were dominant in other study seasons, males dominant in 1981 were physiologically more like subordinates: they had elevated basal cortisol levels and sluggish secretion of cortisol in response to stress; they also no longer had a transient rise in testosterone levels during stress. This finding suggested to me that the "better" profiles seen in dominant males in other years derived in part from the sense of control and predictability that comes with sitting atop a stable hierarchy. Although the dominant males in 1981 had the same high rank and power observed in dominant males in other years, they did not have the same sense of security.

Similar results have been found by many investigators who study captive primates, such as rhesus and squirrel monkeys. When new social groups are forming, dominant males are found to have high basal levels of both cortisol and testosterone and to be highly aggressive. Once a dominance hierarchy is stabilized, a picture emerges that resembles my sketch of the olive baboons in stable times.

The research on captive animals also indicates that the optimal hormonal profile seen in dominant males during stable times is an effect and not a cause of one's high rank. If hormonal traits accounted for dominance, the captive animals would have had different profiles even before new social groups were formed, but they did not. Thus, the beneficial physiology seen in dominant males seems to emerge from, instead of giving rise to, dominance and to arise only when dominance brings with it certain psychological advantages.

My most recent studies have altered my thinking about the influence of rank on physiology. They indicate that the advantageous physiology enjoyed by dominant males in a stable hierarchy is not a result of dominance after all. Rather, the "better" physiology found in the dominant males as a group is accounted for by a subset of animals that have certain personality traits. The traits



DOMINANT BABOONS with certain personality traits (*dark blue*) have lower basal levels of cortisol than do other dominant males (*light blue*), which suggests that attitude is a more important mediator of physiology than is rank alone. Dominant males who can distinguish between the threatening and neutral actions of a rival have cortisol levels that are about half as high as those of other dominant males (*a*). Similarly, low cortisol levels are found in males who start a fight with a threatening rival instead of waiting to be attacked (*b*); who know which fights to pick, and so are likely to win fights they initiate (*c*); who distinguish between having won and lost a fight (*d*); or who, when they do lose, take out their frustration on subordinates (*e*).

apparently enable the animals to take full psychological advantage of their high rank and may, in fact, have helped the animals become dominant in the first place.

My student Justina C. Ray and I discovered the importance of personality when we analyzed the behavior of dominant males, formalizing as many distinct elements of "style" as we could imagine. (Similar studies of subordinates are now under way.) We found low basal cortisol levels—our marker of optimal physiology—only in males who have at least one of the following characteristics: they differentiate well between the neutral and threatening actions of a rival (as evinced by acting differently after each of these events); when a rival is in fact threatening, they control the situation by initiating a fight; they behave differently after winning and losing a fight; and they displace aggression onto a third party if the fight is lost. Dominant males who lack such abilities have basal cortisol levels similar to those of subordinate males.

The general thrust of these findings is consistent with the advice routinely delivered by stress-management mavens, who say that being able to predict and control the outcome of social interactions and to find outlets for tensions can go a long way toward blunting the long-term effects of stress. The wisdom of this advice is underscored by the magnitude of the difference in basal cortisol levels between dominant males who have such traits and those who do not; the difference between these two groups is actually greater than the difference between the cortisol levels of the dominant males as a group and those of the subordinates. This finding indicates that the number of social stressors to which an individual is subjected is less important to physiology than is the emotional style with which one perceives and copes with the stressors.

Studies of human subjects too have shown that a sense of control and outlets for distress are beneficial to physiology. For instance, in one classic study parents whose children had cancer were shown to have elevated cortisol levels. The amount of elevation varied, however, depending on the parents' coping style. Far lower cortisol levels were found in parents who had psychological defenses against anxiety, including religious faith, an ability to deny the seriousness of the child's illness, or a tendency to displace anxiety by becoming engrossed in the details of caring for the child.

It is perhaps platitudinous to conclude that attitude counts, that one must differentiate between what can and cannot be changed (and accept the latter), that one should find footholds of control and predictability in difficult circumstances. And yet my studies as well as many others have shown that stress-related physiology is remarkably sensitive to these platitudes and that the psychological filters through which external events are perceived can alter physiology at least as profoundly as the external events themselves.

For humans and animals as clever as humans, the stressors of life are predominantly socially generated ones that are both subtle and ambiguous. To the extent that so many of our stressors are the inventions of the mind, so too must be the means of coping with them.

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