

Sick People Smell Bad: Why Dogs Sniff Dogs, Humans Sniff Humans, and Dogs Sometimes Sniff Humans

“The smell of a body is the (bacteria themselves) which we breathe in with our nose and mouth, which we suddenly possess as though (they) were (the body’s) most secret substance and, to put the matter in a nutshell, its nature. The smell which is in me is the fusion of the (bacteria) with my body...”

Adulterated, in the interest of good science, from Sartre 1967, p. 174.



A man can live many lives. Paul Ehrlich has. Once, he was a butterfly biologist. Another time, he wrote the book called The Population Bomb, a book that triggered global conversations about the fate of humanity. Still another, he described the relationship between plants and the animals that eat them. A plant evolves, he says, to escape its herbivores and then the herbivores evolve, in response. This war goes on, he found, forever.

All of these and others of the lives of Paul Ehrlich have been lauded. I want to talk about the life of Ehrlich no one ever seems to mention at the award ceremonies, Ehrlich’s life as the guy at the party with the one good liner, the one that everyone laughs at even though it crosses, some say tramples, unspoken social lines.

The specific one liner I am talking about here is one I heard when Ehrlich visited North Carolina State University, where I work. I was helping to host his visit and he and I were talking at the back of a large conference room. We were both looking at the backs of a crowd of hundreds gathered in front of us and, of all things, discussing back pain. We agreed—back pain is terrible. He told me to take care of my back and then, as he looked to the audience and stepped forward through the crowd to give his talk, he left me with a sentence somewhere between punch line and universal truth...“**back problems all started when we began walking upright. The other bad thing about walking upright is that it made it hard to sniff each other...**”¹ With that, he strode, upright, to the stage and began to speak.

Sometimes, when I think of Paul Ehrlich, I think of people sniffing each other. *And as several new studies reveal, when it comes to sniffing each other, men are like dogs. Women are too.*



Two dogs engaging in what Ehrlich called “the good old days.”

The Yin and Yang of Dogs—With dogs, we have all seen it happen. A man and a woman walk down the street toward each other, one with a black lab on a blue leash, the other with a beagle on a white leash. As they approach, the dogs notice each other and circle, awkwardly, until one begins to sniff the other. It is an event simultaneously vulgar and everyday. Sometimes the woman’s dog sniffs the crotch of the man, to which the man inevitably says something like “ooooohh, goodness, he must smell my cat.” As everyone seems to know, this is the “greeting” of dogs. **What no one seems to know is what information is being conveyed in such a greeting.** Is it really just “hi!” or is there more being whispered by a dog’s ass?

Before we answer that question I’ll posit our **ancestors did what the dogs do.** Living on four legs, they saw and smelled some version of what dogs see and smell, which is to say, the rich and fetid world of odors around them, but also of each other. Then, as Ehrlich points out, they stood up, which caused many problems for their and our backs, and made it much harder, in a casual interaction, to take a whiff of each others business. Sniffing one and other then became a part of our history, not who we are, simply who we were. Or so it might seem.

Many generations have passed between those days when we walked on all fours and today. Our stance changed as we began to climb into the trees and then, again, as we climbed back onto the ground. Many other things changed too though, among them how and where our bodies produce odors.

The **scent produced from a dog’s body comes, in large part, from their apocrine glands.** These glands are nearly everywhere on a dog’s body, but are **largest and most dense in a dog’s two anal sacs.** **We also have these glands,** if not the large sacs dogs and other carnivores use to house them. If we did bend over and smell each other, in other words, we would smell a version of what dogs smell (through less sensitive noses, though our sense of smell is better than tends to be appreciated). **What has changed in this time is the location of these glands.** When **primates evolved,** these **glands shifted** such that they are clustered **not just on the bottoms of primates, but also on their tops.** **Primate chests are very often covered in apocrine glands.** This is true in gibbons, but also capuchin monkeys, macaques and many other primates, including all of the apes. **Natural selection favored individuals with genes for producing glands in places where the sniffing would be, well, easy.** **Like humans, gorillas and chimpanzees also have a high density of these glands in their armpits,** where their hair is also denser. It must have been with the common ancestor of humans, chimpanzees and gorillas in which the armpit, in all its reeking glory, evolved².



The Garden of Bodily Delights?—There are many mysteries related to apocrine glands, one of which is how they produce their odors. This is one of the few mysteries that is, at least partially, resolved. Although mammalogists tend to talk about the stinking secretions of these glands, the **secretions themselves are largely odorless**. At least in primates and foxes³, and I suspect in dogs, the **stink comes instead from what the secretions feed—bacteria**. Each apocrine sweat gland feeds bacteria, many of them of the genus *Corynebacteria*, though hundreds of species can be present in a given cluster of apocrine glands. These **bacteria, depending on their species, mix, and abundance, produce the unique odor characteristic of a monkey’s chest or, in all likelihood, your dog’s butt**. In other words, your **dog stinks because it feeds special bacteria that produce an odor that, in turn, communicates a specific message to other dogs**.

The idea that other mammals communicate using the odors of bacteria is fascinating to me. The question becomes just what they communicate. You might be surprised to know very little is known about just what dogs are doing when they sniff. Through such sniffing they can discern whether or not the animal they are sniffing is a boy or a girl, though presumably this is already readily apparent to a dog by the time they get close enough to start sniffing. But what else? No one knows.

In primates, the stories are clearer, if not yet clear. When primates sniff each other, they can use **odors to identify individuals**. They also identify individuals who smell better, either in terms of their status or their loveliness. In terms of the latter, the bacteria being cultivated by these primates on their bodies are, in one form or another, potentially sexy, a garden of foul delight. Yet, what we know about the odors produced by non-human primates still seems to be only part of the story, a hint of a more complicated bouquet.



A gorilla displaying, proudly, its axillary apocrine glands. I don't speak gorilla, but am pretty sure this means, "I dare you to sniff me."

One dog's backside is another man's armpit—A little more may be revealed when we think about Paul Ehrlich's body, or yours or mine for that matter. **Human bodies have apocrine sweat glands too.** Just as in dogs they are found in what biologists euphemistically call "**the peri-anal region,**" (or maybe that is the opposite of a euphemism) **as well as around their genitals.** But they are also found in our **armpits.** Our armpit odor is produced nearly exclusively by the odor of bacteria that are, in turn, fed by glands in our armpits⁴. In other words, when you sniff, however unintentionally, the odor of your neighbor's armpits you are doing exactly the same thing a dog is doing when it sniffs another dog's behind. This gets me back to Paul Ehrlich's joke, the one about the good old days of sniffing each other, nose to tail.

It appears **we never really stopped sniffing each other.** We just, quite accidentally, started **doing so in a more decorous manner, as a function of having stood up.** This, I suppose, is what the joke bemoans, the good ole days of less decorum, but it leaves unanswered the question of **just what information is being transmitted** when we sniff other people, or when dogs sniff other dogs, or, for that matter, when dogs smell on someone else the odor of their cat.

I will start in answering this question by saying that it is clear that the **answer we have is only partial,** but at least three things seem to emerge consistently across species.

I stink therefore I am—In smelling other individuals we can apparently tell who they are, or at least who they are not. We can, as a recent study conducted by high school students indicates, at the very least identify our own smell, and, with a reasonably high frequency, that of a friend⁵. Maybe this is not significant in our daily lives. Maybe it is, but at least in broad terms it seems true. A group at Mahidol University in Thailand has recently published a paper showing that **an electronic nose they have developed (I kid you not), can also tell between the odors of different people on the basis of their bacteria**⁶. We smell different because they, the bacteria, are different⁷. In deciding how to act toward others, who to bite, throw a stick at, or attempt to toss out of a tree (or an office),

knowing who is who seems important. Maybe it is less important for humans than it was for our ancestors and yet we can clearly still perform the trick.

You sure have a pretty smell—Once, when I was living in Knoxville, Tennessee I was sitting behind a man and a woman on a bus when he turned to her and said, "You sure have a pretty smell to you," to which she said "thank you," and then initiated more of a conversation. Smelling pretty is, actually, a big part of why our bodies spend energy feeding bacteria. **We may not think of the odors of armpits as pleasant, and yet our subconscious mental circuitry appears to be constantly evaluating the smells of others and choosing between them.** In smelling other individuals we are able to rate their sexiness and we appear to do so in ways that might benefit our potential offspring's well being. For example, when we discern among odors, we tend to rate the **odors of individuals with different immune (HLA) genes as more favorable than the odors of individuals with similar immune genes.** **Mating with folks with different immune genes will tend to confer a greater immunological diversity to your offspring, which in turn is likely to make them better able to defend against a diversity of potential pathogens.** **Many of the choices we make on the basis of body odor appear heightened when women are ovulating,** and decisions about preferences are most likely to truly be decisions about mates. For example, **when ovulating, women tend to prefer the smells of behaviorally dominant men**⁸.

Pardon me sir, I don't think I smell very well—The most recent revelation about our smells, the news item of the last few months, is that **humans appear to be able to discern the smells of sick and healthy individuals and prefer the odors of healthy ones.** For a number of years, **scientists have known that mice infected with any of a variety of parasites—be they lice, protists, gut worms or viruses—are less sexy to other mice than are uninfected mice**⁹. Just last month Mikhail Moishkin and colleagues at the Institute of Cytology and Genetics in Novosibirsk, Russia, published a study in which they had **female volunteers compare the odor of the sweat of healthy men, men infected with Gonorrhea and men who had been treated for Gonorrhea. The women consistently rated the odors of the men with Gonorrhea as worse than either those without the disease or those who had already been treated for it**¹⁰. If you are sniffing someone, being able to detect that they might be sick (or more specifically that they might have Gonorrhea) based on the smell of their bacteria seems incredibly useful. Might we be able to discern sickness and health more generally on the basis of odors? The mice can. I bet we can too, but time and more experiments in which teenagers sniff sick people will tell.



Our odors may be displays, like the peacock's tail, displays that were once honest, but with the invention of perfumes and deodorants have become, perhaps, corrupt.

The peacock's armpits—The truth is no one has yet assembled these pieces into a complete evolutionary story. There is a small amount of research on dogs, which tends to focus on behaviors rather than on odors. In non-human primates, there is much more research on how individuals make choices based on odors, but less research—virtually none—on the bacteria themselves. In humans, there is research on the bacteria and research on the odors, but the two bodies of literature are largely separate.

I'll take a stab at the story that winds all of these bodies of research together. Perhaps, our bodies evolved the ability to feed bacteria in order to produce smells that signaled both who we are (in terms of our identity and relatedness) and how we are (in terms of our health). Because the bacteria need food and are influenced by our microbial health, they provide an honest signal, like a peacock's tail, of our fitness. A sick peacock has an ugly tail, a sick dog, monkey or man, may well have an ugly odor. All of this seems to fit with what we know, perhaps with the added twist that in highly social organisms—which include dogs (AKA wolves), monkeys and humans—smell has the potential to also convey some measure of social dominance or lack thereof, where alpha males smell sexier than the poor reeking chumps who get beat up at the beach.

But the puzzle is only partially assembled. A world of details remains unresolved. How costly are the foods we give to the bacteria we farm in our armpits and elsewhere? By what means do pathogens influence the way we smell? How do our brains process different odors? **It appears as though most of the mental circuitry associated with processing bodily smells is subconscious, as for many social signals⁹. We make many of our most important decisions about how to regard each other without having those decisions ever rise to above the sea of the subconscious.** So much for free will, but I digress; **the point is we don't really understand how our brains process the odors of others.** We also don't really know how the bacteria of different parts, individuals, or species differ and what consequences those differences have. A woman once asked me at a talk, why her armpits smell sweet when she visits the desert. I don't know the answer,

but differences in the bacteria we farm and consequently how we smell must exist as a function of where and how we live.

Then there is a final piece to this story, the issue of subterfuge. **Very early in our human history**, we began to **take advantage of smells produced elsewhere in nature to perfume our bodies**. We think of perfume as lovely in moderation, but there is another way to **think of perfume, as a way to cheat**. When you apply deodorant or perfume, you are **covering up the odors produced by your bacteria** with an odor regarded as pleasant, at **least to the conscious brain** and perhaps, if the perfume and deodorant companies have done their jobs, to the subconscious too, which is important since that seems to be where the decisions are being made¹¹. I'm not sure where this leaves us other than with the impression that nearly the entirety of modern humanity has figured out how to smell like a peacock. **Beware** both the wolf in sheep's clothing and the **Gonorrhea that smells like Old Spice**.

All of this leaves me with the question of **why dogs sniff people's crotches**. As Paul Ehrlich might say, if he were a dog, maybe it is just because standing on two legs to reach people's armpits is bad for their backs. Or maybe, in sniffing where they do, dogs call our bluff. Even when our armpits say "Old Spice," where dogs sniff still has the potential to say, "Gonorrhea." No matter what perfume we wear, we can be dogged by the truth.

For more about how our interactions with other species, be they microbes or tigers, shape who we are, read Rob's book, [The Wild Life of Our Bodies](#).

For those who would like to learn more about the evolution of the bacteria in our armpits, gorilla's armpits, monkeys chests and dog's backyard gardens, you won't have to wait long. Julie Horvath-Roth and David Kroll, both now at the Nature Research Center are beginning a new project, in collaboration with yourwildlife.org to study the species we actively, but subconsciously, seem to be farming on our skin. For now, stay tuned, or just keep your nose to the wind.

1-For the record, this is the *least* crude bit of humor I've ever heard from Paul Ehrlich, even on that particular day.

2-See Ellis, R. A., Montagna, W. 1962. The skin of primates VI. The Skin of the Gorilla (*Gorilla gorilla*). *American Journal of Physical Anthropology*. Vol. 20: 72-93. In this article it is concluded, apparently, for the first time that among the apes only the gorilla and the chimpanzee have an "axillary organ" (AKA stinky armpit) like that in humans.

3-See, for example, Gosden, P. E., Ware, G. C. and E. S. Albone. 1975. The microbial flora of the anal sacs of the red fox, *Vulpes vulpes* and of certain other carnivores. Although the literature on the microbiology of animal smells is often discussed as though it is new, in 1975 E.. S. Albone was already suggesting that the odors produced by the anal sacs of lions, mongooses, dogs, tigers, maned wolves, bush dogs, domestic cats and foxes were produced by microbial "fermentation" of fats produced by the apocrine glands in these sacs. These anal sacs, although they have a terribly unappealing name, are really

very much gardens. Helen Keller was a fierce advocate of sensory gardens with species planted in them with strong and characteristic smells. Carnivores already have such gardens in their, well, you know... Albone, E. S. and G. C. Perry. 1975. Anal sac secretion of the Red Fox, *Vulpes vulpes*... *Journal of Chemical Ecology*. 2: 101-111.

4-It is because of these glands, it has been argued, that we maintain hair in our armpits and around our privates, so as better to waft the smells of bacteria out into the air. Our conscious minds may cover bacterial odors up with deodorant, but our subconscious bodies rather consistently say, instead, "yo, smell this." For a nice discussion of pubic and armpit hair in the context of our evolution (and that of lice) see... "Weiss, R. A. 2009, Apes, Lice and Prehistory. *Journal of Biology*. 20. (doi:10.1186/jbiol114)

5-Olson, S. B., Barnard, J. and L. Turri. 2006. Olfaction and Identification of Unrelated Individuals: Examination of the Mysteries of Human Odor Recognition. *Journal of Chemical Ecology*. 32: 1635-1645. DOI 10.1007/s10886-006-9098-8

6-A surprisingly large literature on electronic noses exists, but for this particular article see Wongchoosuk, C. et al. 2011. Identification of people from armpit odor region using networked electronic nose. *Defense Science Research Conference and Expo (DSR)*. [10.1109/DSR.2011.6026826](https://doi.org/10.1109/DSR.2011.6026826)

7-When trained dogs pursue an individual person (trained, for example, based on the smell of their clothes), they are doing so based on the odors of their bacteria too. Mosquitoes, recent research has shown, also cue in on humans on the basis of bacterial smells. People with more bacteria are more attractive to mosquitoes. All of this together indicates that while the way we look is largely based on our own cells that the way we smell, our smell-identity if you will, is entirely a function of other species. You are who they, the bacteria, are.

8-Havlicek, J., Roberts, S. C., and J. Flegr. 2005. Women's preference for dominant male odour: effects of menstrual cycle and relationship status. *Biology Letters*. 1: 256-259. doi: 10.1098/rsbl.2005.0332

9-It should also be discerned from this sentence that scientists spend a slightly unhealthy amount of time thinking about the sexiness of mice.

10-The other details of this study are also of interest. The men who had higher antibody titers, as would be expected if their immune systems were more actively fighting the Gonorrhoea, smelled even less pleasant to the women. The authors of this study think that the immune system itself is triggering odors that lead to differential choices by the women though it seems plausible to suspect that these smells, like nearly all, human odors, are mediated by bacteria. Interestingly, the sick men did not just smell unpleasant, they smelled "putrid," in contrast to the healthy men who were categorized as tending to smell either floral or some nuanced mix of floral and putrid. Moishkin, M. et al. 2011. Scent Recognition of Infected Status in Humans. *The Journal of Sexual Medicine*. DOI: 10.1111/j.1743-6109.2011.02562.

11-For an absolutely fascinating discussion of social signals and the extent to which they are subconscious see this paper by Bettina Pause, although I will warn you that it will leave you feeling as though you have very little control over the biggest decisions in your life. 2011. Processing of Body Odor Signals by the Human Brain. *Chemosensory Perception*. DOI: 10.1007/s12078-011-9108-2. It is from this paper that I stole the lovely and apt quote from Sartre.

Images: Paul Erlich: [Stanford News Service](#); Two dogs: [Vik Cuban](#) on Flickr; Dog sniffing Eliza Dushku ([all over the Web](#), let me know if you can find the original photographer); Gorilla: [tomsowerby](#) on Flickr; Ruth St. Denis in The Peacock: [New York Public Library](#) on Flickr.



About the Author: [Rob Dunn](#) is a science writer and biologist in the Department of Biology at North Carolina State University. His first book, *Every Living Thing*, told the stories of the sometimes obsessive, occasionally mad, and always determined, biologists who have sought to discover the limits of the living world. His new book, *The Wild Life of Our Bodies*, explores how changes in our interactions with other species, be they the bacteria on our skin, forehead mites or tigers, have affected our health and well being. Rob lives in Raleigh, North Carolina with his wife, two children, and lots of microbes. Follow on Twitter [@RobRDunn](#).

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