Beauty in the Eye of Neural Networks

Though stunning, the tail feathers of a peacock can nonetheless leave practical-minded people wondering just how useful such a gaudy body part can be.

Charles Darwin attributed the evolution of long feathers, as well as the elaborate courtship calls, songs, colors, and rituals of many animals, to sexual selection based on a species' individual aesthetic sense. Other biologists have argued that these displays enable a male to strut his stuff, so to speak. Only strong males could thrive with all that extra plumage or with colors or sounds that make them more visible to predators. Over time, ever more exaggerated traits evolve to make these males ever more alluring to the female, so the theory goes.

Now, two animal behaviorists have new evidence that a female's preference for such fine feathers may have little to do with seeking a fit mate. Their results indicate that a neural mechanism may account for an animal's aesthetic tastes, exerting its selective pressures in the development of not just courtship traits, but all kinds of signals, says Anthony Arak, now at Archway Engineering Ltd. in West Yorkshire, England.

"These [displays] might not be associated with differences in male quality but could be an artifact of the female's need to recognize males of her species," he explains.

For their experiments, Arak and Magnus Enquist from the University of Stockholm in Sweden use neural networks, computer models that mimic the information processing done by groups of nerve cells. Their network simulates a female bird's visual system. It consists of 36 light-sensitive units that relay image data to 10 processing cells, which in turn transmit numerical signals to an output cell. A high enough numerical value at the output cell indicates that recognition has occurred.

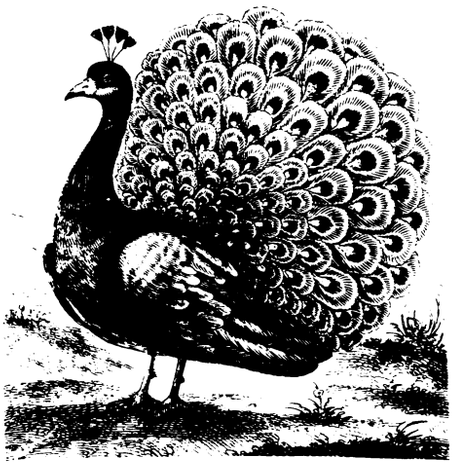
To pick out a male of the same species, the female depends on a few key characteristics. Those characteristics stimulate the right combination of nerve cells in the right proportions, but they also enable her to generalize and recognize the male from different angles and in a variety of conditions. This fuzziness in the recognition leaves room for evolution to occur, Arak notes.

He and Enquist first "evolved" a network to use the long arm of a cross as its key recognition characteristic. This arm represented a male bird's long tail. They allowed their network to mutate by adjusting the strength of its connections. In each "generation," they kept only the network most able to pick this image over other patterns – such as crosses with arms of equal length or one short arm – that represented shapes of similar species. The researchers repeated the selection process to evolve a network that always made the correct choice.

Then they showed the network novel patterns that represented random mutations in the male's shape: longer, broader, or crooked tails, for example, or longer wings. They allowed both shape and network to mutate. Some of the new shapes elicited stronger recognition responses than the originals – so much so that the exaggerated shapes became the preferred mate choice, Enquist and Arak report in the Feb. 4 NATURE.

In addition, some desirable shapes, such as broad wings, bore little obvious resemblance to the original. "It suggests that a system that has evolved or been trained to recognize certain [stimuli] can respond to novel or unusual stimuli that are qualitatively different than stimuli seen before," says Mark Kirkpatrick, an evolutionary biologist at the University of Texas at Austin.

Thus a dazzling tail may not be a badge of fitness, but simply something that arouses a greater response from the female's recognition system. "Males are stumbling onto ways to exploit the female's recognition system," comments Walter Wilczynski, a neurobiologist at the University of Texas at Austin. "Females are choosing them because of some quirky bias in that system."



"That's a sort of technical definition of beauty," Arak says.

The results have implications for people as well as animals. "Maybe the things we find beautiful are just those that are hitting the hidden biases of the recognition system," says Arak. "It's a by-product of our [signaling] system."

He and Enquist intend to investigate further the role of the nervous system in setting aesthetic standards. "We're animal behaviorists coming in and standing on the toes of people who have been studying aesthetics," says Arak. "We have some new ideas that may have some impact on their thinking." – *E. Pennisi*

Wood wins, plastic trashed for cutting meat

Chefs know that, any way you slice it, wooden surfaces are kinder to knife blades than either plastic or glass. But in recent years, everyone from kitchen suppliers to the Department of Agriculture (USDA) has urged cooks to cut on nonporous materials, typically plastic. Supposedly, plastic boards give bacteria, such as *Salmonella* in chicken, less chance of escaping rigorous cleaning, thus reducing the chance that such bugs will survive to contaminate other foods.

If such arguments have frightened you away from slicing, dicing, or boning on wood, you may be able to bring your butcher block out of retirement. New research indicates that the safety advocates were wrong: Pathogens prefer plastic.

No one was more surprised by this than Dean O. Cliver and Nese O. Ak, two microbiologists at the University of Wisconsin-Madison. They began studying cutting boards in hopes of identifying decontamination techniques that might render wood as safe as plastic.

But the pair quickly found that within three minutes of inoculating wooden boards with cultures of common food-poisoning agents – up to 10,000 cells of *Salmonella, Listeria,* or *Escherichia coli* – 99.9 percent of the bacteria were unrecoverable and presumed dead. Under similar conditions, none of the bugs placed on plastic died.

Indeed, when the researchers maintained plastic boards overnight at high humidity and room temperature, microbe populations grew; the researchers recovered no live bacteria from wood the next morning.

The scientific literature suggests that the number of *Salmonella* cells that might wash off a chicken carcass probably will not exceed about 1,000, Cliver notes. "We can get less than 99.9 percent kills [on the wooden boards in three minutes] if we go to inordinately high levels of inoculation" – such as 1 million or more bacterial cells, he says. In those instances, he and Ak had to wait about two hours before achieving a 99.9 percent reduction in the bugs they recovered.

While the wooden boards appear to kill bacteria, "we've not recovered the little

critters' dead bodies," Cliver acknowledges. "So all we know is that by the best available means, we can't get them back after they go onto a board." The big concern is whether bacteria hiding deep within the wood might subsequently surface to contaminate the foods on the chopping block. "As best we can tell, that isn't going to happen," Cliver says.

The same is not true of knife-scored plastic cutting boards. The scientists found that bacteria lodged in the plastic's cut grooves not only survived a hot-water-and-soap wash, but could later surface to contaminate foods. By contrast, Cliver says, with wood "a good wipe will do fine – and if you forget to wipe the board, you probably won't be too bad off."

At one point, the Wisconsin researchers inoculated wood and plastic on three successive days, maintaining each board – without cleaning – at room temperatures and high humidity. By that time, "the plastic boards were downright disgusting," Cliver says, "while the wood boards had about 99.9 percent fewer bacteria than [Ak] had put on them."

"Wood is more forgiving – and perhaps user-friendly – than plastic is once it's been cut some," Cliver says.

Boards sold to homeowners typically come from the factory treated with mineral oil. "That treatment is intended to make the wood more impermeable – like plastic," Cliver says. "The bad news is that it does make wood more like plastic. . . . In every one of our tests, if the wood had been treated to retard the penetration of moisture, the bacteria survived longer."

Wood's presumed bactericidal activity does not depend on whether it is new – nor, apparently, on species. Cliver and Ak have already tested boards from hard maple, birch, beech, black cherry, basswood, butternut, and American black walnut. Tests on oak and ash are pending.

The microbiologists hope to submit their findings for publication within the next few months. One weakness, Cliver notes, is their inability to nail down a mechanism or agent responsible for wood's antibacterial properties.

Although no laws prohibit commercial establishments from using wooden cutting boards, the Food and Drug Administration's model codes for state agencies call for using only "nonabsorbent" and easily cleaned materials for surfaces that food contacts. The USDA also recommends acrylic or other nonporous materials to consumers asking about preferred cutting boards, according to Bessie Berry with its Meat and Poultry Hotline in Washington, D.C.

Cooks should never cut on glass, she says, because minute shards may chip off and become embedded in food.

Microbiologist Priscilla Levine of USDA's Food Safety and Inspection Service says she knows of no scientific studies demonstrating the advantages of one cutting-board material over another in inhibiting bacterial contamination. She told SCIENCE NEWS that her agency based its recommendations on "common sense."

Like state and local inspectors, these federal agencies have "bought the myth" that plastic is safer than wood, says food scientist O. Peter Snyder, a St. Paul, Minn.-based consultant to the retail-food industry. For at least two decades, he says, "sanitarians [sanitation inspectors] out there have been telling us to use plastic cutting boards, even though they had no evidence that plastic was better."

Indeed, Snyder contends, the little research done on the subject has failed to demonstrate plastic's superiority. He cited one study conducted about 25 years ago that showed wooden cutting boards were at least as good as plastic when it comes to cleaning off microbial contamination.

If others confirm the Wisconsin data, Snyder says, sanitarians may have to alter their advocacy in favor of wood. But, he adds, considering how slowly practices change in the food business, 10 years after such confirmatory data came in "sanitarians would probably still be requiring [retail establishments] to use plastic cutting boards." *– J. Raloff*

Dream sleep: A risk for heart patients?

To sleep: perchance to dream: ay, there's the rub/For in that sleep of death what dreams may come. . . .

William Shakespeare wrote of the dark side of sleep in *Hamlet*. Now, a team of Iowa researchers suggests that the dreaming stage of sleep poses a particular peril for people with coronary artery disease.

Humans spend about one-third of their life in sleep. Despite the popularity of sleep, scientists know very little about the physiological changes that occur during slumber. They do know that people typically pass through repeated cycles consisting of several stages of deep sleep followed by a bout of REM sleep, named for the rapid eye movements that take place at that time, when dreams occur.

In 1989, researchers at Harvard University Medical School discovered that people with arterial disease who wake up at night run the risk of ischemia, a reduction in blood flow to the heart (SN: 11/25/89, p.341). That finding fits with the observation that heart attacks often occur in the morning, just after a person wakes up. Indeed, scientists know that REM sleep occurs more frequently during the predawn hours and is associated with an activation of the sympathetic nervous system, which regulates involuntary bodily functions such as heart rate and blood pressure.

To get a detailed picture of what happens during the wee hours, Virend K. Somers and his colleagues at the University of Iowa College of Medicine in Iowa City recruited eight healthy people to spend the night in a sleep lab. The researchers hooked the recruits up to devices that recorded brain waves, heart rate, and blood pressure. By inserting electrodes into the volunteers' leg muscles, the team kept tabs on the sympathetic nervous system.

They found significantly lower heart rate, blood pressure, and sympathetic nervous system activity during non-REM sleep than during wakefulness. This is the first REM study of normal volunteers sleeping at night rather than during the day, Somers says.

The team also reports that REM sleep is associated with a surge of sympathetic nervous system activity. Indeed, these data extend the understanding of dream sleep by finding that sympathetic nervous system activity more than doubled during REM sleep. The researchers describe their findings in the Feb. 4 NEW ENGLAND JOURNAL OF MEDICINE.

"The most striking finding was the association between REM sleep and very, very high levels of sympathetic discharge," Somers says. "We think this may be a potential mechanism that explains the high incidence of heart attacks and strokes in the very early morning hours."

Of course, the Iowa group studied only healthy volunteers and thus cannot prove the link between REM sleep and heart attack risk. However, Somers and other scientists believe that the risk of heart attack starts as the sympathetic nervous system revs up – a process that makes platelets more likely to stick together and already clogged arteries more likely to spasm. During REM sleep, a blood clot may begin to form in the heart's coronary arteries. However, the heart attack doesn't occur until that clot grows large enough to shut off the heart's blood supply, perhaps several hours later, when the victim is rushing to get to work on time.

For people who think the solution to heart attack risk is to spend less time in bed, sleep researcher Richard L. Verrier of Georgetown University in Washington, D.C., warns that sleep deprivation results in a rebound effect. Sleepy people make up for lost time by going through heavy periods of REM sleep, he notes. People with artery disease may benefit from the commonsense advice to get plenty of sleep – and thus avoid heavy REM periods, he says. *– K.A. Fackelmann*