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.

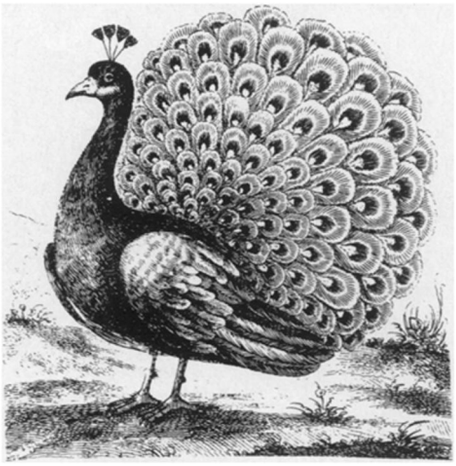
To pick out a male of the same species, the female depends on a few key characteristics. Those characteristics stimulate the right combination of nerve cells in the right proportions, but they also enable her to generalize and recognize the male from different angles and in a variety of conditions. This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

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