food increases the risk of other diseases not normally found in these populations, such as cancer, heart disease and diabetes. This poses a dilemma for public-health officials: they encourage the Inuit and others to eat traditional foods, but advise them to reduce their consumption of such foods.

I enjoyed reading Cone's book, especially her descriptions of conversations with indigenous people and scientists in different parts of the Arctic. This discussion would have been improved if she had also visited the indigenous families of the Russian Arctic. These families, which constitute almost half of all indigenous people in the Arctic, face serious health risks. The collapse of the Soviet economy left them dependent on traditional food, increasing their risk of chemical exposure.

Cone presents the science of Arctic toxicology and the Arctic paradox in an interesting and readable way. She also presents some solutions and predictions about the pollution problem. The Stockholm Convention, which will ban the use and production of a 'dirty dozen' chemicals, is an important step towards a reduction in the production and use of man-made chemicals. Although the concentrations of some chemicals (such as PCBs and DDT) are decreasing in the Arctic environment, others are becoming more common, especially mercury, brominated and fluorinated compounds. There is an urgent need for action, from both industry and government agencies. To this end the European Commission has made a plan for the testing and regulation of chemicals. Unfortunately, it seems harder than ever to ban toxic substances in the United States.

Silent Snow is an important book that should be read by environmentalists, scientists, politicians and the public. The environmental problem of man-made chemicals, addressed in this and previous books, should send a clear message to the rest of the world. ■

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Dissecting the right brain

The Ethical Brain
by Michael S. Gazzaniga
Dana Press: 2005. 226 pp. £17.50, $25.00

Paul Bloom

It matters to me what Michael Gazzaniga thinks about the brain and, if you live in the United States, it should matter to you too. In 2002, Gazzaniga was appointed to the President's Council on Bioethics and so his views on cloning, euthanasia, neurological enhancement and embryonic stem cell research will help shape US law and policy. Gazzaniga is an admirably clear writer who assumes no expertise on the part of his reader. Although he says that *The Ethical Brain* was written to encourage fellow neuroscientists to enter the public debate on these issues, it could be read by anyone who has an interest in the controversies that lie at the intersection of science and ethics.

Gazzaniga's main point can be summarized as: Don't Panic. He is sceptical that we will ever be able to create 'designer babies' or pills that lead to effortless improvements in human performance. He argues that 'mind-reading' techniques such as functional MRI and implicit tests of racial bias are actually of limited value when it comes to determining moral or legal responsibility. And he is confident that individuals can make competent decisions about the proper use of technologies such as cloning and neurological enhancement. With just a few exceptions, he believes the government should stay out of such decisions.

He is particularly dubious about slippery-slope arguments of the type: we can't let people do X, because even though X is ok, it might lead to Y and Y is terrible. As he puts it, "It does not make moral, political, or social sense to allow the fear of the extreme to hinder the good."

He also addresses the big questions, such as how to reconcile the common-sense notion that people possess free will and are responsible for their actions with the scientific view that, as physical objects, our actions are fully determined. Gazzaniga's solution is to distinguish brains from people — "Brains are automatic, but people are free." Responsibility is "a social construct that exists in the rules of a society, [it] does not exist in the neuronal structures of the brain". For him, scientists have nothing to say about such issues: they should stay in their labs and out of the courthouse and legislature.

This may be a bit too cautious. Even if Gazzaniga is right that responsibility is a social construct and that for a neuroscientist, no person is more or less responsible than any other, there are reasonable and unreasonable ways to apply this construct. If a paranoid schizophrenic kills someone while in a delusional state, we do not (and should not) punish him or her as we would a mafia hit man, because of what we know about schizophrenia. In this regard, science does bear on questions of moral responsibility, particularly with regard to difficult issues such as how to deal with crimes committed by teenagers, or by those with learning difficulties.

Gazzaniga is a lot less cautious when it comes to the implications of neuroscience for ethics in general. As he puts it in his preface, "I would like to support the idea that there could be a universal set of biological responses to moral dilemmas, a sort of ethics, built into our brains. My hope is that we soon may be able to uncover these ethics, identify them, and begin to live more fully by them. I believe we live by them largely unconsciously now, but

RICK BOWMER/AP

IMAGE UNAVAILABLE FOR COPYRIGHT REASONS

Left hanging: this demonstration in April 2002 put pressure on the US Senate not to ban therapeutic cloning.

that a lot of suffering, war, and conflict could be eliminated if we could agree to live by them more consciously."

This conclusion would follow if our universal moral sense had been implanted by an all-knowing and all-loving God. But biological evolution is a notoriously amoral force. Innate moral universals would have been shaped by the selective advantages that arise from caring for our kin and cooperating with our neighbours, but nothing in our genes tells us that slavery is wrong, or that men and women deserve equal rights. Such insights emerge through individual and group processes that engage all of our faculties, including our innate moral sense, but also the capacity to appreciate abstract arguments, formulate analogies, learn from experience, take other's perspectives and so on. Much of moral progress consists of using reason to override our gut feelings.

An excellent illustration of why ethics does not reduce to instinct comes from Gazzaniga's own treatment of issues such as stem cell research and euthanasia. This shows ethical reasoning at its best — rooted in common sense but also informed by a sharp, inquisitive mind and a deep appreciation of the facts. ■

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SCIENCE IN CULTURE

Eddies at The Gates

An art installation hints that, even in a forest, wind may disperse tree seeds farther than expected.

Henry S. Horn

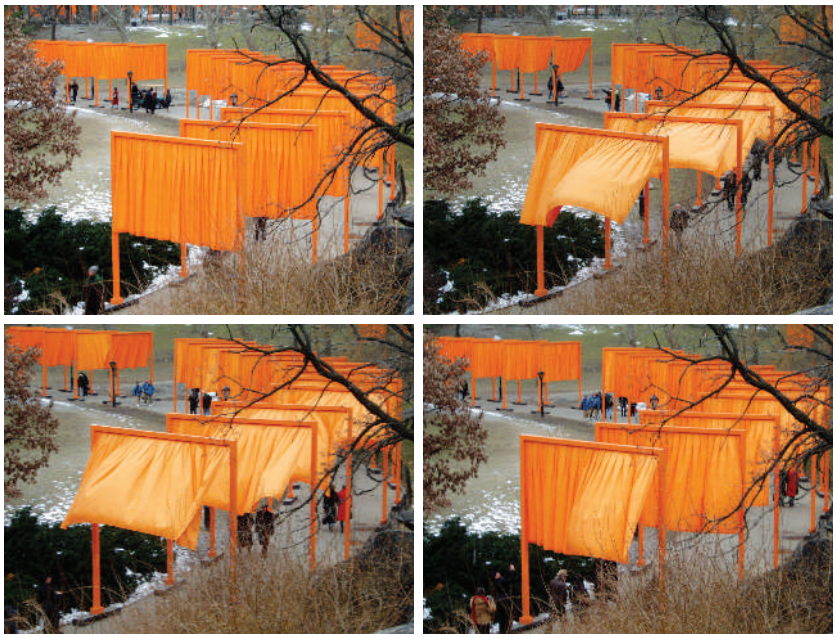
Tree seeds that are dispersed by the wind have parachutes, wings or sails to slow their descent. This keeps them in the airflow longer, allowing them to travel farther. But the assumption has been that a seed falling in a forest is doomed to travel only a short distance, because the wind is impeded as it passes among the trees.

To travel far, a seed must rise above the forest canopy on an updraft whose velocity exceeds the rate of fall of the seed in still air. If the updraft is part of a coherent rolling eddy, the seed might 'surf the wave' to a great distance. To guess how far a seed might get, it becomes important to know the sizes and lifespans of coherent wind eddies, but it seems that no one has made the appropriate measurements.

My colleagues and I have produced computer models that predict wind dispersal over long distances, but it has been difficult to convince others that our models are realistic (Nathan *et al. Nature* **418,** 409–413; 2002; *Div. Distrib.* **11,** 131–137; 2005). A visit to The Gates, Christo and Jeanne-Claude's temporary art installation in New York's Central Park this February allowed me not only to visualize coherent eddies, but also to measure their sizes and local lifespans. The measurements came from 57 photographs that I took with a digital camera on the afternoons of 24, 25 and 27 February 2005.

The Gates in Central Park, New York City, 1979–2005 comprised 7,500 gates, around 4 metres apart and 5 metres high, following the line of the paths through the park. Saffron-coloured fabric panels were hung from the top of each.

When there was no detectable wind or only a light breeze, the fabric of The Gates hung vertically with minimal flutter. The panels billowed out to within 20° of the horizontal for winds recorded near the ground at 2 to 5 metres per second (www.cdo.ncdc.noaa.gov/ulcd/ULCD). I measured the 'footprint' of a coherent eddy by counting a consistent number of contiguous billowing gates and calculating the distance they span. Footprints spanning at least 12–13 gates (about 45 metres) were common at wind speeds of 2 to 5 metres per second. From timed sequences of photographs of sets of gates, I recorded local lifespans of 32 to 57 seconds.



H. HORN

Seeing ghosts: a 58-second sequence showing the waxing and waning of a 25-metre eddy.

These records are biased toward shorter lifespans, as I chose to photograph sequences only when the gates were changing orientation rapidly. Some eddies lasted longer than 100 seconds, and the their footprints tended to move along a line of gates at scales of about 100 metres.

Seeds that are kept aloft by updrafts in a 45-metre coherent eddy, for 50 seconds, in a horizontal wind of 5 metres per second, could travel at least 0.25 kilometres. This is farther than we thought, even though the measurements behind the calculation are all substantial underestimates.

Thanks to Christo, Jeanne-Claude and The Gates, I now have direct quantitative observations, in moderate winds, of the coherent eddies that are crucial to long-distance dispersal of seeds and other biotic agents. Praise is also due to Christo for having anticipated realistic sizes for the wind eddies that drive The Gates in his conceptual drawings, which were made before construction of the work itself.

Of course, the aerodynamic presence of The Gates is part of the landscape that may interact with the generation and propagation of coherent eddies. Some details are likely to be peculiar to Central Park, and even to the installation itself. Nevertheless, the general pattern and its spatial and temporal scales are highly suggestive of features to be expected in a natural landscape. So the seed can indeed fall far from the tree.

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