

Rendering the Visible Invisible



Clever experiments reveal how unconscious mechanisms can affect our brain and our behavior **BY CHRISTOF KOCH**

WHAT IS CONSCIOUSNESS? What is this ineffable, subjective stuff—this thing, substance, process, energy, soul, whatever—that you experience as the sounds and sights of life, as pain or as pleasure, as anger or as the nagging feeling at the back of your head that maybe you’re not meant for this job after all. The question of the nature of consciousness is at the heart of the ancient mind-body problem. How does subjective consciousness relate to the objective universe, to matter and energy?

Consciousness is the only way we experience the world. Without it, you would be like a sleepwalker in a deep, dreamless sleep, acting in the world, speaking, having babies, but without feeling anything. You would feel nothing, *nada, nichts, rien*. Indeed, in the most famous deduction of Western thought, philosopher and mathematician René Descartes concluded that because he was conscious he existed. That was his only unassailable proof that he wasn’t just a chimera. Maybe

he didn’t have the body he thought he had, maybe he had fake memories (premonitions of *The Matrix*), but because he was conscious he must exist.

Yet the questions go on. Are only people conscious? What about a fetus? What about a neurological patient in a persistent vegetative state, such as Terri Schiavo (who died in 2005), who can’t do much more than open and close her eyes? Although many are willing to accord sentience, consciousness, to our beloved cats and dogs, what about apes, monkeys, whales, mice, bees and all the other critters on the planet? Can a fly be conscious? What about artificial consciousness? Is your cool iPhone sentient? Can machines ever become conscious, as is widely assumed in so many science-fiction novels and movies?

Until recently, these questions were purely within the domain of speculative philosophy and fantasy. But over the past decades, science has been making huge strides in exploring the

brain. An immense number of psychological, medical, neurobiological and physical stories about consciousness can now be told. Each Consciousness Redux essay will illuminate one facet of one of the most central, enduring and puzzling aspects of the world, subjective feelings.

I am a scientist who seeks rational explanations of ineffable consciousness and of how and why it arises in the brain. But I also realize that our universe is a strange place; there are more things in heaven and earth than are dreamt of in philosophy. So I try to be humble when it comes to one of the most mystifying aspects of this universe—that I wake up each day and find myself conscious, capable of seeing, touching, loving, feeling and remembering. I am not a zombie! Many different traditions besides the modern scientific one have provided answers, and we should not reject them out of hand but listen to them.

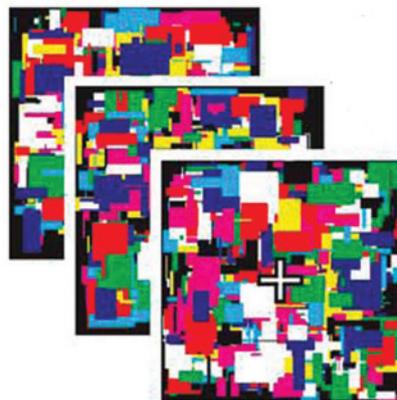
Unconscious Influences

As I write these lines, I am flying back from the annual meeting of the Association for the Scientific Study of Consciousness that took place, this year, in Taipei, Taiwan. It’s a gathering of hard-nosed philosophers, neurologists, psychologists and neuroscientists concerned with consciousness. One of its high points is an annual award, named in honor of the father of American psychology. The 2008 William James Prize for Contributions to the Study of Consciousness went to Naotsugu Tsuchiya, a young neurobiologist from the California Institute of Technology. What had he done that caught the attention of the prize committee?

In 2005 Tsuchiya invented a technique, continuous flash suppression,

Stationary image in one eye

Random flashed patterns in the other eye



A constantly changing set of colored and overlaid rectangles projected into one eye (right) suppresses a static image of an angry face shown to the other eye (left). An observer with both eyes open sees only the flickering mosaic.

FATMA KONUSKAN (Koch); COURTESY OF NAOTSUGU TSUCHIYA (angry-face experiment)

(The mind has many nooks and crannies; some are accessible, but most are **hidden from introspection**.)

which renders a picture invisible, hiding it from your conscious sight. Yet some part of your brain has access to the image and influences your behavior in untold ways. The way it works is simple. Say Tsuchiya wants to camouflage a picture of an angry male face. With the help of a split computer screen, Tsuchiya projects a faint image of this snarling guy into your left eye. Your right eye sees a rapidly changing set of colored rectangles, one on top of another [see illustration on opposite page]. If you keep both eyes open, all you see are the ever changing series of colored patches but no angry face. The constantly flickering colors attract your attention in a way that the static portrait does not. As soon as you close your right eye, the face becomes visible. But otherwise you have no inkling that the face is there, even though your left eye has been staring at it for many minutes. You simply do not see it. So what is the big deal?

Subconsciously Active

Functional brain imaging shows that this angry face still activates a part of your brain that is concerned with fear, the amygdala. That is, at least some sector of your brain knows about the face—as it ought to because an angry male face in front of you might spell big trouble. This brain activity remains unconscious but may influence your behavior or generate a subtle feeling of unease.

Using this technique, psychologist Sheng He, with his student Yi Jiang and their colleagues at the University of Minnesota, made an intriguing discovery. They projected to one eye a photograph of a naked person on one side of the gaze and a scrambled version of the same image on the other side. They then hid both using continuous flash suppression [see illustration above]. The paid volunteers who participated in the experiment never saw



A photograph of a naked woman or man is shown to the left of the gaze in one eye while a scrambled version of the same image is shown to the right of the gaze. Both images are hidden from conscious sight by the ever changing, evanescent colored shapes. Yet sensitive measurements show that an observer does attend, unconsciously, to the invisible photograph depending on the observer's own gender and sexual orientation.

anything but flashes of color. The psychologists asked the volunteers to guess whether the naked person was in the left or the right part of the image. But they couldn't. Their guesses were no better than chance.

He and Jiang demonstrated that the observers attended to the naked picture but not to its scrambled counterpart. Even more interesting, straight males attended to pictures of naked women but were slightly repelled by pictures of naked men. Straight women were attracted to pictures of naked men without showing a consistent repulsion for pictures of naked women. Gay men behaved much like straight women; they unconsciously paid attention to the pictures of the naked men but not to those of women. What is disconcerting about this experiment is that this all took place outside the pale of consciousness. Because the observers never actually saw the naked images, they had no idea they were attracted or repelled by them. This ex-

periment is scary because it seems as if people's sexual orientation could be inferred (statistically) from their unconscious attentional biases. An example of the unconscious mind at work. Freud would have loved it.

What this experiment teaches us is that the mind has many nooks and crannies; some—probably the minority—are consciously accessible, whereas most are hidden from introspection, lost in the vast catacombs of the brain. Yet they can powerfully influence your behavior, making you do things without knowing why. Continuous flash suppression—and other techniques that magicians and psychologists have invented to distract you so you do not see things while looking at them—in combination with functional brain imaging is a delicate tool to map the landscape of the visual unconscious. **M**

CHRISTOF KOCH is Lois and Victor Troendle Professor of Cognitive and Behavioral Biology at the California Institute of Technology.

(Further Reading)

- ◆ **Continuous Flash Suppression Reduces Negative Afterimages.** N. Tsuchiya and C. Koch in *Nature Neuroscience*, Vol. 8, No. 8, pages 1096–1101; August 2005.
- ◆ **A Gender- and Sexual Orientation-Dependent Spatial Attentional Effect of Invisible Images.** Y. Jiang, P. Costello, F. Fang, M. Huang and S. He in *Proceedings of the National Academy of Sciences USA*, Vol. 103, No. 45, pages 17048–17052; November 7, 2006.
- ◆ Web site of the Association for the Scientific Study of Consciousness: www.assc.caltech.edu