Vanished without a Trace

Fading illusions play hide-and-seek with your perception

BY SUSANA MARTINEZ-CONDE AND STEPHEN L. MACKNIK

"I don't think there is anything wrong with white space. I don't think it's a problem to have a blank wall."
—Annie Leibovitz

ACCORDING TO a legend that one of us (Martinez-Conde) heard growing up in Spain, anybody can see the Devil's face. All you need to do is to stare at your own face in the mirror at the stroke of midnight, call the Devil's name and the Prince of Darkness will look back at you. Needless to say, I was both fascinated and terrified by the possibility. And I knew this was an experiment I must try. I waited a day or two to gather my courage, then stayed awake until midnight, got up from my bed, and into the bathroom I went. I closed the door behind me so that my family would not hear me calling out loud for Satan, faced my wide-eyed reflection, made my invocation, and … nothing happened. I was disenchanted (literally) but also quite relieved.

Now, three decades later, a paper entitled "Strange-Face-in-the-Mirror Illusion," by vision scientist Giovanni B. Caputo of the University of Urbino in Italy, may explain my lack of results. Caputo asked 50 subjects to gaze at their reflected faces in a mirror for a 10-minute session. After less than a minute, most observers began to perceive the "strange-face illusion." The participants' descriptions included huge deformations of their own faces; seeing the faces of alive or deceased parents; archetypal faces such as an old woman, child or the portrait of an ancestor; animal faces such as a cat, pig or lion; and even fantastical and monstrous beings. All 50 participants reported feelings of "otherness" when confronted with a face that seemed suddenly unfamiliar. Some felt powerful emotions.

After reading Caputo's article, I had to give "Satan" another try. I suspected that my failure to see anything other than my petrified self in the mirror 30 years ago had to do with suboptimal lighting conditions for the strange-face illusion to take place. Caputo recommended dim lighting, so that observers might see their facial features in detail but experience attenuated color perception. So this time I turned off the bathroom lights and turned on my cell phone's flashlight, then placed it on the floor behind me, so that I could not see its reflection on the mirror. Then I looked at myself and waited.

My efforts were rewarded quickly. Portions of my face started to disappear, contract or expand, and suddenly all the features would come back, giving me a bit of a start. I was particularly thrilled to experience some of the dissociative identity effect that the experimental participants reported, feeling as if the face staring back at me was both mine and yet not mine. Disappointingly, I did not see any monstrous creatures or ghosts of ancestors calling me from the beyond (or even Satan, for that matter), but I think I came close to seeing one of the "archetypal" faces. Weirdly, halfway through the experiment, my face appeared to morph into a sepia portrait of an old Native American warrior. But as soon as it arrived, it was gone.

VANISHING ACT
Camouflage and Troxler fading can pair up to great effect. Look around the image for the leopard. Hint: His head is hiding in the tall grass near the lower right corner. Once you locate it, hold your gaze on the tree trunk while paying attention to the animal's location. He's gone! Look straight at the leopard to revive your perception.

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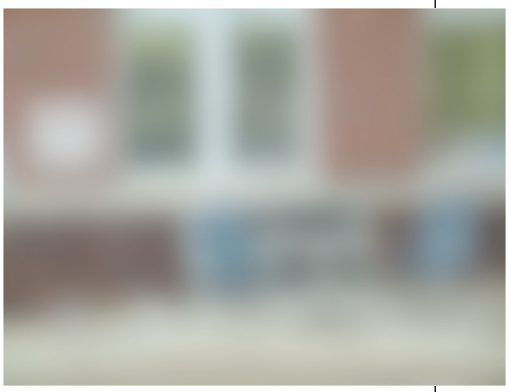
Fade to Gray

Why does this happen? To explain, we need to start with Erasmus Darwin, the English natural philosopher and physician and grandfather of Charles Darwin. In the late 18th century he described how objects can fade after steady gazing: "On looking long on an area of scarlet silk of about an inch in diameter laid on white paper … the scarlet color becomes fainter, till at length it entirely vanishes, though the eye is kept uniformly and steadily upon it." Swiss philosopher Ignaz Paul Vital Troxler later corroborated



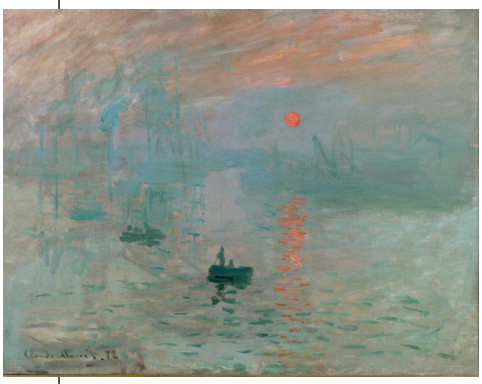
Darwin's observations, using colored patches on a wall. The phenomenon became known as Troxler fading.

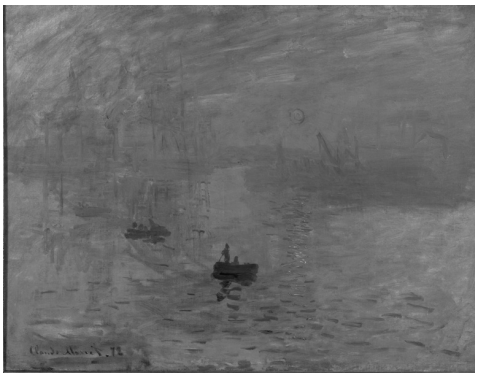
Neural adaptation, the mechanism by which neurons decrease or stop their response to unchanging stimulation, is thought to underlie perceptual fading during prolonged gazing at an object or scene. Once the target of interest has vanished, blinks, gaze shifts and even microscopic involuntary eye movements called microsaccades can restore it to perception instantly [see "Shifting Focus," by Susana Martinez-Conde and Stephen L. Macknik; Scientific American Mind, November/December 2011].

Troxler fading and neural adaptation may partly explain Caputo's strange-face illusion. As we gaze long and steady into our reflected face, the unchanging nature of the visual stimulus causes facial features to disappear and then reappear, as we blink or make involuntary eye movements, thereby "refreshing" our neuronal responses. In the absence of visual information, our brain will "fill in" the gaps according to our experiences, expectations, best guesses, and even hardwired neural mechanisms involved in shape and face perception. The result can be amusing or disquieting.

A few years ago I had the opportunity to collaborate with cognitive scientist Daniel Simons (author, with Christopher Chabris, of *The Invisible Gorilla*, Random House, 2010) and his colleagues at the University of Illinois at Urbana-Champaign on an experiment to investigate visual fading in entire scenes. You can experience the effect by focusing your gaze precisely at the center of the blurry image, while paying attention to the entire scene. Careful staring for just a few seconds will minimize your eye movements, causing the scene to fade to gray. Now stop focusing your gaze, and the scene will come right back. Scientists can make nonblurred scenes fade in the laboratory by completely removing or by compensating for the observer's eye movements. **M**

SUSANA MARTINEZ-CONDE and STEPHEN L. MACKNIK are laboratory directors at the Barrow Neurological Institute in Phoenix. They serve on *Scientific American Mind*'s board of advisers and are authors of *Sleights of Mind: What the Neuroscience of Magic Reveals about Our Everyday Deceptions,* with Sandra Blakeslee, now available in paperback (http://sleightsofmind.com). Their forthcoming book, *Champions of Illusion,* will be published by Scientific American/Farrar, Straus and Giroux.

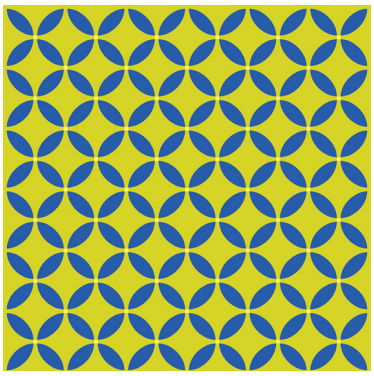




A FADING IMPRESSION

Impression, Sunrise, **by French painter Claude Monet in 1872, gave its name to the Impressionist movement. The subject of the painting is the harbor of Le Havre in France, as seen from Monet's window. It was not, however, Monet's actual view of the scene, as he later explained, but his "impression"—hence the title. Indeed, *Sunrise* does not accurately represent reality: the rising sun appears much brighter than the surrounding sky, as it should in real life, but that perception is an illusion. Monet used pigments of matching luminance, or brightness, but different chromatic content, or hues, to represent the sun and the sky. Harvard University neurobiologist Margaret Livingstone has proposed that this equiluminant quality, where objects in the image have the same luminance as the background, is what gives the sun its eerie, almost pulsating, lifelike appearance. A black-and-white reproduction reveals that the sun has the same physical luminance as the background clouds.**

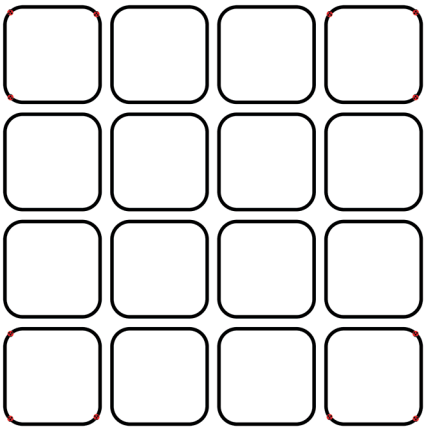
Equiluminant objects are somewhat difficult to see, which makes them more susceptible to Troxler fading. Neuro-ophthalmologists Avinoam B. Safran and Theodor Landis of Geneva University Hospital in Switzerland noticed that if you fix your gaze on the image of the sailor in Monet's painting for several seconds, while paying attention to the sun, the solar disk will disappear progressively, being replaced by the surrounding sky.

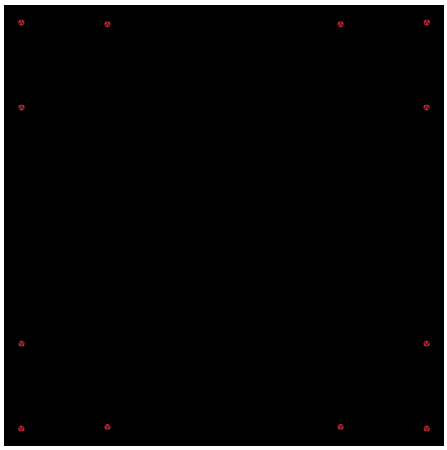


HOW MANY DOTS?

This pattern, generated by vision scientist Akiyoshi Kitaoka of Ritsumeikan University in Japan, contains a yellow dot at the center of each set of four blue "petals." That makes a total of 61 yellow dots! To prove it to yourself, examine each "flower" in turn and see that all of them contain a central yellow spot. The problem is that you can see only one spot at a time. The others disappear when you are not looking at them directly.

COURTESY OF DANIEL SIMONS *University of Illinois at Urbana-Champaign (top);* ERICH LESSING *Art Resource, NY (left);* COURTESY OF AKIYOSHI KITAOKA *Ritsumeikan University (right)*



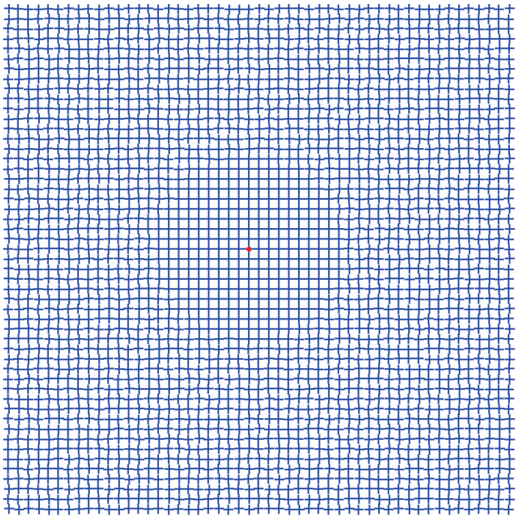


LURKING LADYBUGS

In the left image of the pair that makes up this illusion, also by Kitaoka, each of the four squares in the corners has three ladybugs. The little insects are easy to see as you look around the image, but when you stare at the center of the pattern they vanish immediately. The right-hand image shows they do not become invisible by virtue of the small size: in the absence of the squares, all 12 ladybugs are perceptually prominent, no matter where in the image you look.

THE HEALING GRID

This illusion, created by cognitive neuroscientist Ryota Kanai, then at Utrecht University in the Netherlands, was a top-10 finalist in the 2005 Best Illusion of the Year Contest (http://illusionoftheyear.com). Explore the image freely, and you will see a regular pattern of intersecting horizontal and vertical lines in the center, flanked by an irregular grid of misaligned crosses to the left and right. Choose one of the intersections on the center of the image and stare at it for 30 seconds or so. You will see that the grid "heals" itself, becoming perfectly regular all the way through. The illusion results from both perceptual fading and the ensuing neural guesstimates that our brain imposes to "fill in" the outer parts of the image based on the available information from the center, in addition to our nervous system's intrinsic tendency to seek structure and order, even when the sensory input is fundamentally disorganized.



BEAUTY IN THE EYE OF THE BEHOLDER

Artwork may contain "errors" that are obvious to our central vision but become invisible when viewed from the corner of our eye. Neuroscientist Denis Pelli of New York University discovered that Pablo Picasso's *Maquette for Guitar* (1912) appears absurd only when we look at it directly: the strings are torn and twisted, the neck is crooked, and the body is split into disconnected pieces. But now focus on the cross, while still paying attention to the guitar: all you can see is the smooth curves and elegant angles of a beautiful instrument. Pelli hypothesizes that the illusion works because our peripheral vision confuses the locations of the parts. Failure to notice the errors in the maquette produces the perception of a real guitar. Picasso's paintings of Nusch Éluard, a French acrobat, show a similar phenomenon. When viewed directly, the portraits are grotesque, but when seen peripherally, the young woman looks exquisite. Pelli suspects that Picasso was well aware of this effect.

(Further Reading)

- **The Vanishing of the Sun: A Manifestation of Cortical Plasticity.** A. B. Safran and T. Landis in *Survey of Ophthalmology,* Vol. 41, No. 5, pages 449–452; March–April 1998.
- **The Moving Tablet of the Eye: The Origins of Modern Eye Movement Research.** Nicholas J. Wade and Benjamin W. Tatler. Oxford University Press, 2005.
- **Vanishing Act.** Art Wolfe and Barbara Sleeper. Bulfinch, 2005.
- **Induced Visual Fading of Complex Images.** D. Simons, A. Lleras, S. Martinez-Conde, D. Slichter, E. Caddigan and G. Nevarez in *Journal of Vision,* Vol. 6, No. 10, pages 1093–1101; September 26, 2006.
- **Vision and Art: The Biology of Seeing.** Margaret Livingstone. Abrams, 2008.
- **Strange-Face-in-the-Mirror Illusion.** G. B. Caputo in *Perception,* Vol. 39, No. 7, pages 1007–1008; 2010.
- **Shifting Focus.** S. Martinez-Conde and S. L. Macknik in *Scientific American Mind,* Vol. 22, No. 5, pages 48–55; November/December 2011.