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Illusions: The Eyes Have It

Eye gaze is critically important to humans, as social primates. Maybe that's why illusions involving eyes are so compelling.
By Susana Martinez-Conde and Stephen L. Macknik

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FOLLOW MY FINGER: No matter from which direction you look at this image, the finger appears to be pointed directly at you.

This is the third article in the [Mind Matters](#) series on the [neuroscience behind visual illusions](#).

The eyes are the windows to the soul. This fact is why we ask people to look us in the eye and tell us the truth. Or why we get worried when someone gives us the evil eye or has a wandering eye. Our everyday language is full of expressions that refer to where people around us are looking. Particularly if they happen to be looking in our direction.

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As social primates, humans are very interested in determining the direction of gaze of other humans. It's important for evaluating their intentions, and critical for forming bonds and negotiating relationships. Lovers stare for long stretches into each other's eyes, and infants focus intently on the eyes of their parents. Very young babies look at simple representations of faces (such as smileys) for longer than they look at similar cartoonish faces in which the eyes and other features have been scrambled.

In this slide show, we're going to investigate a series of illusions that take advantage of the way the brain processes eyes and gaze. It turns out that it's fairly easy to trick us into thinking that someone is looking somewhere else, or that [Albert Einstein is actually Marilyn Monroe](#).

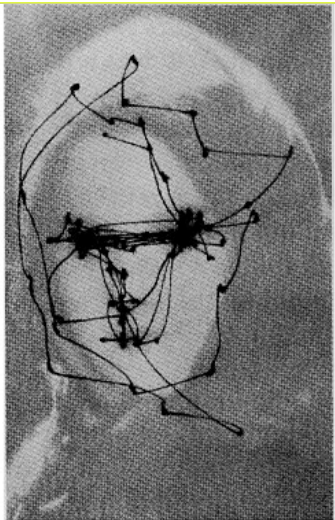
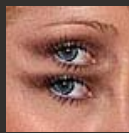
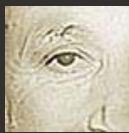
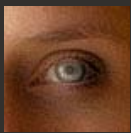
Mind Matters is edited by [Jonah Lehrer](#) the science writer behind the blog [The Frontal Cortex](#) and the book [Proust Was a Neuroscientist](#).

ABOUT THE AUTHOR(S)

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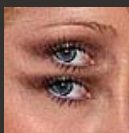
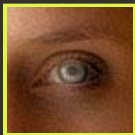


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About 50 years ago Russian psychologist Alfred L. Yarbus tracked the eye movements of volunteers as they viewed photographs of human faces, and found that the eyes of the portraits were a primary area of interest for most observers. In contrast, one hallmark of autism is a lack of [attention to faces](#). But even though we pay lots of attention to the area of the face around the eyes, we are still forced to take lots of shortcuts when figuring out where someone is looking. These sensory shortcuts are what make us so vulnerable to visual illusions involving gaze.

ENLARGE



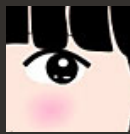
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Not knowing where a person is looking makes us uneasy. For this reason, it can be awkward to converse with somebody with dark sunglasses. And it's why someone might wear dark sunglasses to look "mysterious." A recently identified visual illusion takes advantage of the unsettling effect of uncertainty in gaze direction. The "Ghostly Gaze" illusion, by Rob Jenkins (University of Glasgow, U.K.), was awarded the 2nd Prize in the last edition of the [Best Visual Illusion of the Year Contest](http://illusioncontest.neuralcorrelate.com) (held May 12, 2008, in Naples, Florida; <http://illusioncontest.neuralcorrelate.com>). In this illusion, two twin sisters appear to look at each other when seen from afar. But as you approach them, you realize that the sisters are looking directly at you!

The illusion works in this way: it is a "hybrid" that combines two overlapping pictures of the same woman. The two overlapping photos differ in two important ways: their spatial detail (fine or coarse) and their direction of gaze (sideways or straight ahead). The photos that look at each other contain only coarse features, and are thus best seen from afar. The photos that look straight ahead are made up of sharp details, which can be best seen at close range. When you approach the pictures, you are able to see all the fine detail, and so the sisters seem to look straight ahead. But when you move away, the gross detail dominates, and the sisters appear to look into each other's eyes.

ROB JENKINS, UNIVERSITY OF GLASGOW

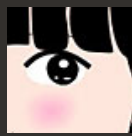
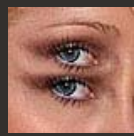
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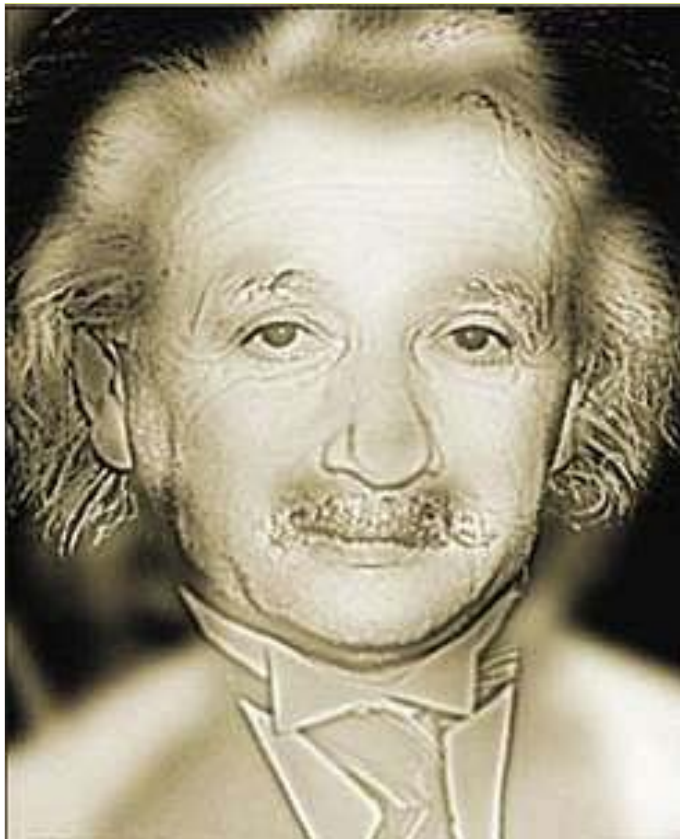
In another example of a hybrid image (see previous slide), this ghostly face appears to look to the left when you sit in front of your computer screen. Step a few meters back, however, and she will start to look to the right.

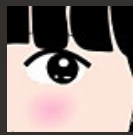




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The Ghostly Gaze illusion is based on the hybrid image technology created by Aude Oliva and Philippe Schyns at the Massachusetts Institute of Technology. In a shocking example of how perceptual interpretation can vary with viewing distance, Albert Einstein (seen from up close) becomes Marilyn Monroe (seen from a few meters away). For more hybrid images, be sure to visit the hybrid [image website](#).





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SEEING DOUBLE?

But what if you double up the features of a portrait in without overlapping them completely? It's relatively easy to create images in Photoshop in which the eyes and the mouth, but no other facial features, have been doubled. The results are little short of mind-bending: as the brain struggles (and fails) to fuse the doubled-up features, the photo appears unstable and wobbly, and observers experience something akin to double vision. The neural mechanisms for this illusion may lie within our visual system's specialized circuits for face perception. If you double up the eyes and mouths in a portrait, the neurons in the face recognition areas of the brain may not be able to process this visual information correctly. Such failure could make the faces more unsteady and difficult to perceive.



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The perceived direction of gaze is also influenced by contextual cues, such as the position of the face and the head. This illusion was described in 1824 by British chemist and natural philosopher William Hyde Wollaston (who also discovered the elements palladium and rhodium).

IMAGE COURTESY OF AKIYOSHI KITAOKA

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Have you ever visited an art museum and noticed that the portraits seem to follow you with their eyes? Such eye tracking is not only a B-movie horror flick cliché, but also a powerful illusion that continues to inspire visual science studies. In 2004 vision psychologists Jan Koenderink, Andrea van Doorn and Astrid Kappers from University of Utrecht in The Netherlands, along with James Todd from Ohio State University, concluded that, contrary to popular belief, this compelling illusion does not require special artistic abilities on the part of the painter. Surprisingly, all that is required is that the person portrayed looks straight ahead, and the visual system takes care of the rest. The deceptively simple explanation is that, although we may look at a picture from various viewing angles, the picture itself never changes. That is, when we look at a real sunset, the visual information that specifies near and far points changes with viewing direction. But when we observe a picture or photograph hanging on the wall, the visual information that defines near and far points remains unaltered, irrespective of viewing angle. Our brain interprets this information as if pertained to a [real-world 3-D object](#), however. The perceptual ambiguity results in the eerie effect of having the eyes of the portrait follow you across the room.

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A fascination with eyes is not solely a human trait. Many species of fish, insects, and even birds sport false (one could say illusory) eyes on their wings, stalks, and yes, even the backs of their heads. These eye-catching patterns serve to dissuade and confuse potential predators. So get an eyeful of the false-eye designs in the accompanying slides!

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