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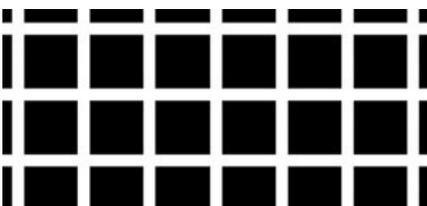
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Optical Illusions: When Your Brain Can't Believe Your Eyes

Intriguing Images Suggest Seeing Isn't Always Believing

By **CARI NIERENBERG**
ABC News Medical Unit

Oct. 13, 2009—

Look at an optical illusion and you may think you're seeing things -- such as a curved line that's actually straight, or a moving object that's standing still. You wonder if your [eyes](#) are playing tricks on you.

It's not your eyes. An illusion is proof that you don't always see what you think you do -- because of the way your brain and your entire visual system perceive and interpret an image.

Visual illusions occur due to properties of the visual areas of the brain as they receive and process information. In other words, your perception of an illusion has more to do with how your brain works -- and less to do with the optics of your eye.

An illusion is "a mismatch between the immediate visual impression and the actual properties of the object," said Michael Bach, a vision scientist and professor of neurobiophysics at the University of Freiburg Eye Hospital in Freiburg, Germany, who studies illusions and has a [large collection of them on a Web site](#).

Everything that enters the senses needs to be interpreted through the brain -- and these interpretations occasionally go wrong, Bach told ABCNews.com. Illusions, he said, may serve as a test bed to determine whether scientists understand vision correctly.

[Susana Martinez-Conde](#), director of the laboratory of visual neuroscience at [Barrow Neurological Institute](#) in Phoenix, Ariz. offered a similar definition. "An illusion is a phenomenon in which our subjective perception doesn't match the physical reality of the world."

Although people popularly call some brain teasers "optical illusions," this might not be the best term for them, as scientists make a distinction between optical illusions and what they call visual illusions.

An optical illusion suggests that the illusion arises because of some properties of the eye, Bach pointed out.

But since optical illusions are rare, a better and more accurate term is "visual illusions," because this helps to explain why these perceptions happen.

The Floaters

A good example of an optical illusion  one that actually occurs inside the eye  is floaters.

Floaters are small specks, spots or shadowy shapes that seemingly float in your field of vision. To some, they

look like a bright white snow or flashes of light.

Floaters are caused by tiny irregularities in the fluid that fills the eye. In other words, they're real. They become more common as one gets older.

But nearly every other illusion happens at the brain level, which is why scientists say they shouldn't be called "optical illusions," and why the term "visual illusions" is more appropriate.

Instead of thinking that you cannot trust your eyes when you see an illusion, you really should be saying, "I cannot always trust my visual system," said Bach. The visual system includes not only the eyes but the optic nerve, which links the eye to the brain; and the primary visual cortex, the area of the brain that processes visual information.

Another example of an illusion is when you "see stars" after a hard blow to the head.

According to Bach, seeing stars results from a mechanical stimulation and activation of the neurons in the eye, which your brain misinterprets as light. Light does not enter the eye when you hit your head, but your visual system perceives it that way.

What You Can Learn From Optical Illusions

There are other real-world examples of illusions. Pilots might encounter visual illusions while in flight, such as a false horizon, or when landing, such as a narrow runway. They are trained to recognize and ignore these illusions so they can safely fly their aircraft.

But while some illusions may pose a safety threat, others may actually be used as safety measures. On Chicago's Lake Shore Drive, for example, visual illusions have been used to control drivers' speed on a hazardous curve. Stripes on the road are painted closer together as drivers approach the sharpest part of the curve. The illusion makes drivers think they're speeding up -- so they slow down and, it's hoped, have fewer accidents.

Illusions can offer scientists new insights on how vision and the brain work -- and are more than intriguing parlor tricks.

"They widen the mental horizons and make it clear that things are a little different than they seem," Bach said.

Visual illusions are not just some nice puzzle, like a crossword, or an entertainment feature, said Martinez-Conde. "They're important tools in visual research to help us understand how visual processing works in the normal brain and also in the diseased brain."

Beyond their amusement value, one researcher speculated that illusions may also serve an evolutionary purpose.

Seeing the 'Future'

"The brain is always constructing things, which is helping you survive. Some of these constructions can be fiction," said Mark Changizi, a neurobiologist and assistant professor of cognitive science at Rensselaer Polytechnic Institute in Troy, N.Y.

Changizi came up with a theory to help explain why we see illusions. He argued that illusions are due to the brain's attempt to "see" the future. They occur during the slight time lag after light reaches the retina in your

eye, but before your brain translates it into a visual perception.

According to Changizi, author of "[The Vision Revolution](#)," when the brain attempts to generate a perception, it basically is taking a guess at the near future by trying to fast-forward a tenth of a second. As a result of this "neural delay," you might not be perceiving an image as it actually is, but as you expect it might soon be.

"Illusions occur when the brain attempts to perceive the future, and those perceptions don't match reality," he said.

Although there is no single reason illusions take place, Martinez-Conde offered another possible explanation.

The brain is a limited structure with limited resources, including its number of neurons, wires, and neuronal connections, she suggested. "So in some cases, illusions may be due to the brain's need to take shortcuts." Simply put, the brain might need to quickly give more importance to some features in a visual scene than others.

Recognizing the Best Illusions of the Year

Color, motion, shape and the amount of light that hits your eye are just a few of the factors that might cause you to see an illusion.

Some people like to design new illusions and, in fact, there is an annual international contest to recognize the best -- and most novel -- [visual illusion of the year](#). First place this year went to an entry called "[The Break of the Curve Ball](#)," which depicted the path of a spinning disk and helped illustrate why the abrupt shift of this pitch is so good at fooling baseball hitters.

No doubt, the lessons learned from illusions extend beyond the baseball diamond -- and deep into your mind.

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