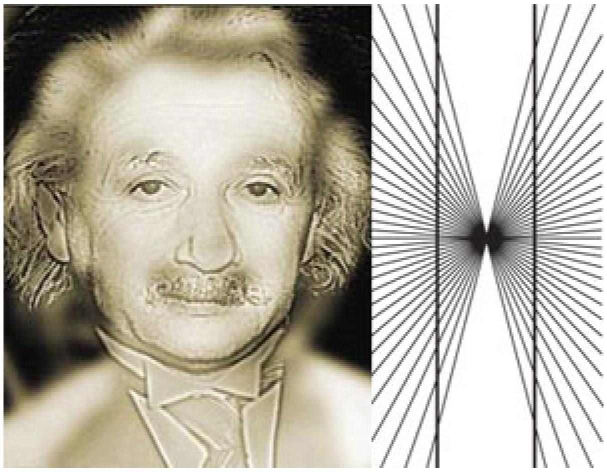

In the Blink of an Eye

Can you believe something is real if you've seen it with your own eyes? Caltech scientists delving into optical illusions believe our brains trick us into seeing something that isn't there … yet.

By John Seeley 03/02/2009

Why, you might wonder, would Caltech's busy scientists be devoting time to the study of optical illusions? Those graphics are fun, but they're usually consigned to the fluffy corners of pop culture that also include crossword puzzles, riddles, rebuses and cartoons. Take, for example, the Einstein-Marilyn illusion where the face of the father of atomic energy seems to morph into the head of the '50s sex goddess when you back away from it a few feet. It's interesting, especially if you know that Marilyn thought old Albert was kind of sexy (yes, really!). Even though that particular illusion involves one of their predecessors — Einstein visited the school in the early 1930s — that's not what compels the Caltech crew. The heads they're focused on are ours, and what they're investigating is how we use them to process visual cues.

Optical illusions used by painters are known as trompe-l'oeil, from the French expression for "trick the eye." But according to former Caltech scientist Mark Changizi (now at Rensselaer Poly in upstate New York) and biologist/psycho-physicist Shinsuke Shimojo, the eye is not the passive victim of trickery but an active collaborator in it. Whenever we see something, there's a tiny lag between the time we receive it as light sensations and the time we comprehend it. Our brain fills the gap by anticipating what we should be perceiving an instant later.

Biologists know that it takes 60 to 100 milliseconds for light hitting the retina's photoreceptors to reach the visual cortex — then another 100 to 200 milliseconds to reach conscious awareness. So is this "neural delay" of one-sixth to one-third of a second important? It is if we want to catch a fast-moving ball, avoid a fall, or — as we did earlier in our evolutionary development — need to know where that springing wolf or saber-tooth tiger is going to be in that fraction of a second. If we're running from harm (good runners can cover 80 to 100 feet per second), the delay leaves us several yards closer to whatever threat we need to escape.

The scientists launched their study of optical illusions, in part, to test their hypothesis — that the brain's visual center offsets the delay by predicting and "seeing" an instant into the future. This is not to be confused with the ability we learn in childhood to calculate where an object will be in the future, based on its direction, velocity and the varying experiences we have with the motion of balloons, boulders or beach balls.

The eye does something similar, but much simpler. In the journal Cognitive Science, Caltech scientists hypothesized that the present we perceive is actually an image that the visual cortex created a fraction of a second ago — mainly by bringing objects we're approaching (or are approaching us) a bit closer — to "predict" the present.

But what if neither person nor object is moving? The predicting distortion still operates, they theorize, scanning for what might be coming closer.

Changizi, Shimojo and company say optical illusions occur because they contain cues that you are approaching them — usually cues of perspective, which indicate a vanishing point and, therefore, "closer" and "farther" parts of the two-dimensional graphic. Of course, most flat art, at least since perspective came into use in the late Middle Ages, fools us into thinking it depicts something three-dimensional. Where optical illusions differ is that the depth cues mislead us. See how the pair of dark lines in the graphic at right seem to bow outward in the middle — in reality they are two straight parallel lines.
The out-curving distortion we all perceive, they say, supports their anticipate-the-future thesis. Here's their logic: First, the converging spoke-like lines "tell us" — through our sense of perspective — that we are headed toward their meeting point. Second, if we were approaching that point, a real space between two upright lines (think of a tall doorway) would seem to be wider in the middle than at the top or bottom.

The fact that this distortion has happened while we are in fact standing still is, they argue, another example of perceiving the future in the present.

Is it solid proof of their theory that what we see is what we're going to get, next instant? Not really, Shimojo acknowledges, but other scientists are also pursuing the same mysteries. Harvard neuro-physiologists waving light sticks at salamanders have found — no, not that they want to dance — but that neurons in their retinas respond to a moving light before the light actually moves into that neuron's "space." Incontrovertible proof that we "see the future" still awaits the work of some future Einstein — or perhaps some future Marilyn Monroe might stumble on the evidence when closely reviewing the action in her latest film.

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