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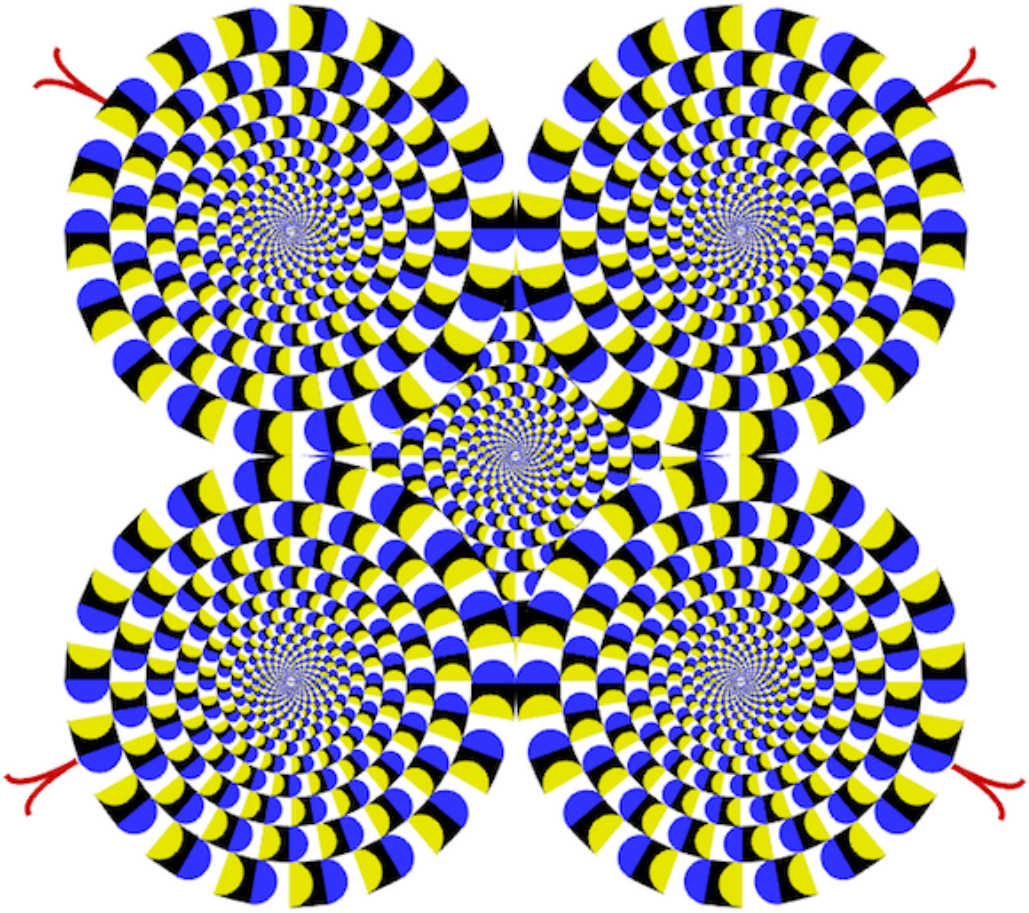
How Our Brains Set the World Spinning



If there's ever excuse to publish an optical illusion as cool as the "Rotating Snakes," I'll take it. This illusion was invented in 2003 by Akiyoshi Kitaoka of Ritsumeikan University in Japan, and ever since, Kitaoka and other scientists have been trying to figure out why it works. A new paper by Stephen Macknik at the Barrow Neurological Institute in Phoenix may have the answer.

As you'll notice, the circles seem to rotate in response to where you look at the illusion. So Macknik and his colleagues tracked the movement of people's eyes as they gazed at two of these wheels on a computer screen. Their subjects kept a finger pressed on a button, lifting it whenever they seemed to see the wheels move.

Macnick and his colleagues found a tight correlation between the onset of the illusion and a kind of involuntary movement our eyes make, known as microsaccades. Even when we're staring at a still object, our eyes keep darting around. These movements, called microsaccades, help us compensate for a peculiar property of the eye: if we stare at an object for too long, the signals each photoreceptor sends to the brain become weaker. Microsaccades refresh the photoreceptors with a different input and breath new life into our perception.

Unfortunately, the jumps of our eyes get in the way of our perception of motion. If we see a snake slithering along in a desert, we don't have to register an entire image of the snake at one instant, then another image at the next instant, and then compare the location of the two images, in order to figure out that the snake is on the move and we might want to jump out of the way. Instead, we only have to sense rapidly changing light patterns in neighboring parts of the eyes. If certain neurons in the vision-processing regions of the brain gets a sudden, strong signal from the eye, they register motion.

Normally, our eyes can register motion despite the fact that they are also performing microsaccades. Our brains can tell the difference between a shift brought on by the movement of an object and one brought on by the movement of our own eyes. But thanks to the strong contrasts and shapes in the Rotating Snakes Illusion, we get mixed up. Our motion sensors switch on, and the snakes start to slither.

Reference: "Microsaccades and Blinks Trigger Illusory Rotation in the 'Rotating Snakes" Illusion.' Otero-Millan et al, The Journal of Neuroscience, April 25, 2012 • 32(17):6043– 6051

[Image: From Akitaoka's snake web site. Many more big screen versions there!]

[Update: I revised this post to correct the explanation of microsaccades and their function. Thanks to John Kubie for his comments and follow-up emails.]

April 24th, 2012 5:00 PM by Carl Zimmer in Brains | 14 comments | RSS feed | Trackback >

14 Responses to “How Our Brains Set the World Spinning”

1. 1. *Jon Brock* Says:
   April 24th, 2012 at 6:28 pm

   Cool. But why do I (and I think most people) see motion only in the periphery?

   Whichever circle I look at, that’s stationary and the other circles are all moving.

   I’m guessing that the fovea (the part of the retina which codes the point of fixation) is better at compensating for microsaccades than the parafovea.

   Guessing further, perhaps the parafovea doesn’t normally need to bother compensating for microsaccades because the retinal “image” is more blurred in the parafovea. Something about the illusion (the high contrast perhaps) overcomes that, giving the motion sensation.

2. 2. *Charles A. Bielasz* Says:
   April 24th, 2012 at 9:13 pm

   What about something as simple as Extraocular Muscle fatigue (Instability?)

3. 3. *Madhav* Says:
   April 25th, 2012 at 12:46 am

   Very interesting. But if these microscaccades cause the illusion, I wonder why we dont get any similar illusion of movement when we see just a rectangular object, with contrastring stripes of colours arranged all along it from left to right.

4. 4. *Mephane* Says:
   April 25th, 2012 at 3:24 am

   @Jon Brock: I have the same experience. Any circle not currently in my focus appears in motion. And it even works if they are cut off by the edge of the browser window.

5. 5. *Frank H Little* Says:
   April 25th, 2012 at 5:45 am

   It would be interesting to know whether someone who has had his sight restored after a long period of blindness experiences the illusion.

6. 6. *Mikalai* Says:
   April 25th, 2012 at 10:40 am

   I just did an experiment.
   Blinking with different frequency.
   The result is next : for fast (60 Hz) blinking the rotation is present,
   for lower 10 Hz frequency the rotation stops. Conclusion : there is a stroboscopic effect, that means we also have to include in analysis the speed of information processing.
   Of course it is not statistically enough to build the conclusion one one person, but …

7. 7. *John Kubie* Says:
   April 25th, 2012 at 11:46 am