# Your Twisted Little Mind

Illusions that distort your perception

BY STEPHEN L. MACKNIK AND SUSANA MARTINEZ-CONDE

VISUAL PERCEPTION begins with our retinas locating the edges of objects in the world. Downstream neural mechanisms analyze those borders and use that information to fill in the insides of objects, constructing our perception of surfaces. What happens when those borders—the fundamental fabric of our visual reality—are tweaked? Our internal representation of objects fails, and our brain's ability to accurately represent reality no longer functions. Seemingly small mistakes lead to the very distorted perceptions of an illusory world. **M**

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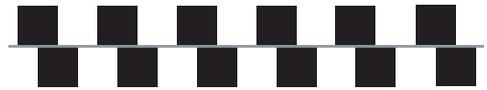

PLUMB CRAZY

No, the architects of this building were not drunk at the drawing board. In fact, the structure is perfectly rectilinear in every way. No slants, no tilts and no curves: just good old traditional 90-degree angles at work here. The Australian architectural firm of Ashton, Raggatt, and McDougall based the façade design at the Port 1010 building in Melbourne on a famous bit of visual trickery known as the café wall illusion, popularized by vision scientist Richard Gregory of the University of Bristol in England. Mark McCourt, a vision scientist at North Dakota State University, has shown that the positions of the black-and-white bricks invoke a reverse contrast effect called brightness induction, which results in the mortar having the appearance of a twisted cord. Vision scientist and illusion creator Akiyoshi Kitaoka of Ritsumeikan University in Japan has further demonstrated this effect in minimalist fashion by isolating it to a single row of mortar with blocks. The alternation of black-and-white brick positions results in an alternating direction in the twisted cords of the mortar. The brain interprets these cords as being slightly tilted depending on the direction of the twist.

CIRCULAR REASONING

Just as twisted cords power the café wall illusion, so, too, do they distort our perception of simple circles. The upper left pair of nested circular twisted cords shows how this subtle local effect can have major global consequences on our perception of shapes, even one as deceivingly simple as a circle. (To convince yourself that these circles do not actually have corners, see the video at www.youtube.com/watch?v=aXndBs0dvdg&feature=plcp.)

The twist in the cords even works when the twisted elements are not touching, as in the spectacular *Intertwining Illusion* by vision scientist Baingio Pinna of the University of Sassari in Italy. Because the interacting visual elements are no longer in contact with one another, Pinna's version is strongest when you see it with your peripheral vision—out of the corner of your eye. Visual neurons processing peripheral information have low spatial resolution, allowing them to "see" the gross details of objects only, so even distant tilted squares produce the perception of a twisted cord. The low resolution of peripheral visual neurons also plays a role in the bizarre *It's a Circle, Honest!* illusion by vision scientist David Whitaker of the University of Bradford in England and a top-10 finalist in the 2007 Best Illusion of the Year Contest (http://illusionoftheyear.com).

On the lower left, the circle looks round only if you look directly at it; if you position it in the corner of your eye, it has corners! The circle on the lower right, which is made of smaller elements, looks more rounded no matter where you position it on your retina because the smaller elements are smeared out to gray in the visual periphery.
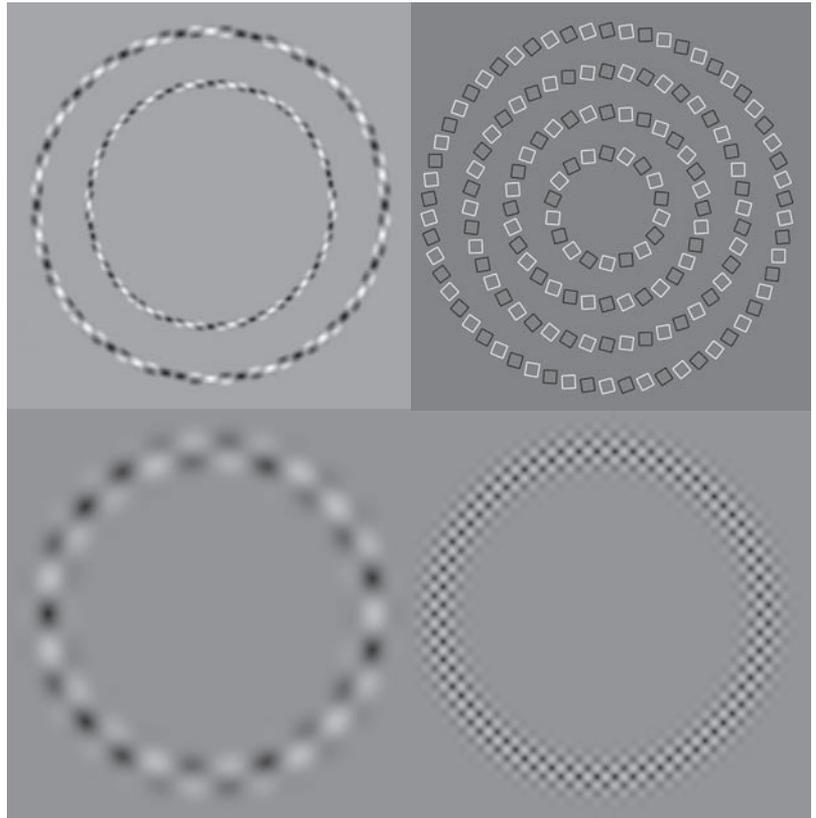
BUILDING THE IMPOSSIBLE, ONE LEGO AT A TIME

Don't believe any of this so far? Think it's all a bunch of camera tricks? Well, you don't have to take our word for it. Go to a Lego store and buy a baseplate that is at least 43 × 43 studs in size, 946 one-by-two tiles (554 black and 392 white), 196 one-by-one tiles (half black, half white), and 240 individual studs (half black, half white). You can then make your own Lego version of *A Bulge,* by Kitaoka.

To see the illusion disappear with a single breath, watch this video at www.youtube.com/watch?v=QKCSBkdEUXQ.

TWISTED SISTER

Women's makeup enhances the attractive facial features while hiding the undesirable. Now there is an outfit to accomplish the same illusory feat for your body. Actor Kate Winslet's dress, created by British fashion designer Stella McCartney, uses contrasting shapes to accentuate hips, shoulders and otherwise highlight the female form. For maximum effectiveness, be sure to wear it only in front of a black background.
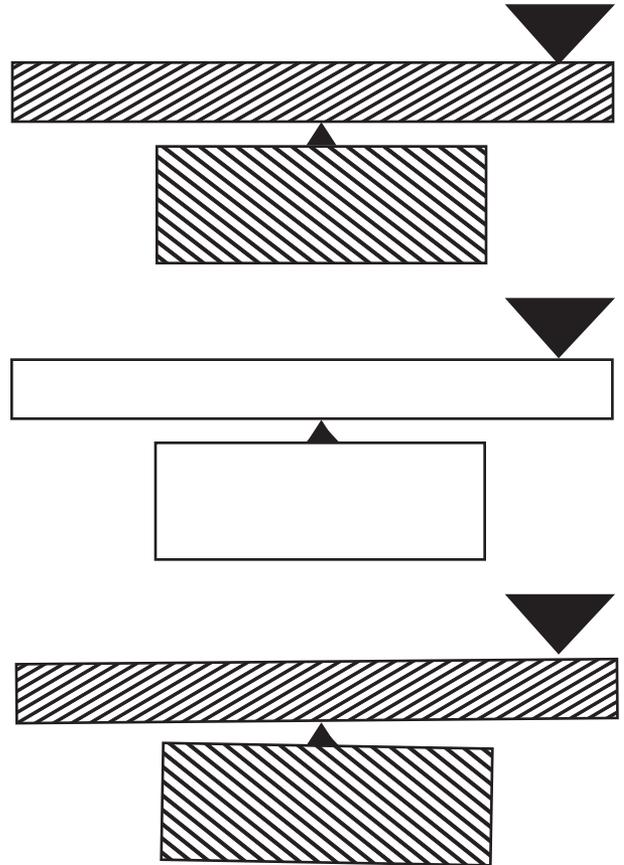
THE TEETER-TOTTER SEESAW

Spatial distortions can be measured for their power to alter perception. The seesaw at the top seems to tilt to the right, although, in fact, it is not tilting at all. If we remove the twisting candy-cane stripes from within, we now see the veridical planks and their untilted truth. A clever variant of this illusion, with a physically tilted plank that appears level through illusory means, reveals that the illusion is equivalent, perceptually, to as much as a four-degree actual tilt.

A nice animated version of the effect is at www.moillusions. com/2009/02/slanted-seesaw-optical-illusion.html

(Further Reading)

◆ **Brightness Induction and the Café Wall Illusion.** M. E. McCourt in *Perception,* Vol. 12, No. 2, pages 131–142; 1983.
◆ **Shifts of Edges and Deformations of Patterns.** B. Pinna and R. L. Gregory in *Perception,* Vol. 31, No. 12, pages 1503–1508; 2002.