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Cool Visual Illusions: The Winking Effect and Other Luminance-Contrast Illusions

Category: **Visual Illusions**
Posted on: May 15, 2007 4:13 PM, by **Chris**

In honor of the announcement of the Best Visual Illusion of the Year (via Steve), I thought I'd revive the old cool visual illusion series. I may post about this year's winner, the leaning tower illusion, in the future, but I just now read the paper, so I have some work to do first. Instead, I'm going to talk about an illusion discovered by one of the members of the team that came in third place this year, the winking effect. To see the effect, you'll have to head on over to the *Journal of Vision* website, which I'll link you to in a minute, 'cause I don't know how to put flash animation into a post. But first, here are the instructions. When you get there, you'll see two dots flashing white and black (you might see some illusory motion, but that's not what we're interested in). After you've watched that for a few seconds, click on the red button next to the words "thick surrounds." After you've watched that for a bit, click on the button next to the words "thin surrounds." When you're all finished, come back here and check beneath the fold. OK, here's the link: "The Winking Effect.

Back? That's friggin' awesome, isn't it? The two synchronized flashing dots suddenly become asynchronous when you put the thick and thin surrounds around them. In case it's not clear, those are the same two flashing dots, still flashing in synchrony, but now instead of blinking, you see winking! As visual illusions go, that's pretty damn strong. So strong that it might be hard to believe, so try this: put your fingers over the top or bottom of the surround (this is best with the thick surround). You should notice that the flashes of the two dots appear to get closer together in time.

So why does this happen? Here's the explanation from Shapiro et al.1:

> In the illustration, the light annulus has a luminance level of 60 cd/m2, the dark annulus has a luminance level of 20 cd/m2, and the center lights have a mean level of 40 cd/m2. The luminance level of the center disks is modulated at 1 Hz with an amplitude of 15 cd/m2. The lower left panel plots the luminance levels of the disks versus time. Because the luminance levels are identical, the two lines plot on top of each other. The lower right panel plots the Michelson contrast of the disks relative to the surround. The contrast signals are modulated in anti-phase. When the luminance modulation is in the light phase, the disk with the light surround has a low-contrast value, and the disk with the dark surround has a high-contrast value; when the luminance modulation is in the dark phase, the opposite occurs.
>
> The effect arises, in part, because of the conflict between the luminance and contrast signals. If our perception tracks the luminance level of the disks, then the disks should appear to be modulating in phase; if our perception tracks the contrast signal, which arises at the edge, the disks should appear to be alternating. Because at low frequencies both aspects can be perceived, the effect indicates that at a relatively late stage of visual processing, the signals that originate from the center of a patch of light can be separated perceptually from signals that originate at the edges. (p. 460)

In other words, in the visual system there's a conflict between the changing luminance of the flashing dots and the contrast between the changing color of the dots and the surround. Because the surrounds are different shades, the differences in the contrast create the illusion that the current shades of the two dots are different. Using this conflict, you can create all sorts of cool visual illusions, as Shapiro and his colleagues have done. Here are some others, from Shapiro, Charles, and Shear-Heyman2:

Window-Shade and Rocking-Disk Illusions: The rocking-disk illusion (click on the thin-surround buttons) is especially cool.

Tilt and Ramp Illusions

The explanation for the "shifting effects" illusions (e.g., the Rocking-Disk illusion) is slightly different (it has to do with center-surround receptive fields), but the basic principle is the same: the luminance and contrast information interact in such a way that the shades appear different depending on the specific relationship between the two.

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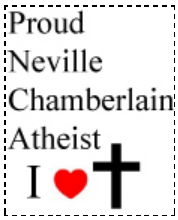
April is the cruelest month, breeding lilacs out of the dead land, **mixing memory** and desire, stirring dull roots with spring rain.



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[1]Shapiro, A. G., D'Antona, A. D., Charles, J. P., Belano, L. A., Smith, J. B., & Shear-Heyman, M. (2004). Induced contrast asynchronies. *Journal of Vision*, 4(6), 459-468.

[2]Shapiro, A. G., Charles, J. P., Shear-Heyman, M. (2005). Visual illusions based on single-field contrast asynchronies. *Journal of Vision*,5(10), 764-782.

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