

## Out of This World

Superpower your imagination

*Superhero science has taught me this: Entire universes fit comfortably inside our skulls. Not just one or two but endless universes can be packed into that dark, wet, and bony hollow without breaking it open from the inside.*

—Grant Morrison, *Supergods*, 2011

An eclectic crowd of cosplay zombies, manga characters, and assorted villains and heroes, all sweltering under their makeup in the Arizona summer heat, presses us along at the 2014 Phoenix Comicon convention. We descend a four-story escalator into the immense Phoe-

nix Convention Center, which sprawls across multiple city blocks of subterranean floor space. As we watch the bottom of the pit rise toward us, demons are brandishing crossbows, war hammers and lightsabers.

Comic book characters live in an augmented reality, a realm where individuals transcend natural capacities. Their stories are human dramas writ large: Superman soars to the rescue, and Spider-Man clambers up buildings to escape villains. The human nervous system offers many ways to be part of this world. Our eyes can take in the tremendous array of colors, light and movement that surround us, and the brain translates this visual maelstrom into something intelligible. In particular, our perceptual and cognitive systems rely largely on seeking out, embellishing and identifying contrast, a principle that is also fundamental to comic stories, with their central themes of good versus evil.

Nobel laureate Haldan Keffer Hartline of the Rockefeller University first discovered the brain's contrast-detecting ability in the neurons of the retina,

which in humans lines the inner surface at the back of the eye. Hartline found that excitation in a neuron leads to suppression of surrounding, competing neurons, so that an enhanced neural response to visual stimuli goes hand in



### WEB OF DECEPTION

Distinguishing a hero from a villain is often all a matter of perspective. In this image by Kurt Wenner, exhibited at Universal Studios Japan to celebrate its 10th anniversary in 2011, only someone viewing from the correct angle (much like the vantage point of a *Scientific American Mind* reader) will see Spider-Man swinging through a New York City canyon, preparing to shoot webs back at the tightrope walkers. The people walking the ropes see the superhero for what he is, a huge, flat painting on the floor below them, and have no fear of falling to their death. This illusion, called an anamorphic painting, takes advantage of how the visual system uses cues such as shading, perspective and relative size to produce our perception of distance, depth and shape.

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hand with the active inhibition of nearby opponent stimuli. Hartline called this process “lateral inhibition.”

Excitation versus inhibition enhances the contours of objects as compared with their interiors, and similar computations operate outside the visual system to have a part in virtually every known brain area. Lateral inhibition may also play a role in how we compare ideas and arguments. Disambiguating the world—heightening the difference among entities—appears to be a neural mandate.

We cannot perceive greenish-red or bluish-yellow, for example, because the corresponding colors are processed as *opponent* types of information in visual neurons. They are like oil and water to the mind.

On the Phoenix Comicon exhibition floor, one of our favorite comic book creators, Dennis Calero, explains that managing dualities is also crucial to superhero lore. Heroes often internalize opposing personas: readers identify with Clark Kent and Peter Parker rather than

with Superman and Spider-Man. Yet just as important, the villain makes the hero. Without a compelling villain, stories fall flat. Contrast between light and dark forces creates the narrative.

The images in this article play on the idea of superpowers and heroes. They challenge your visual and cognitive circuits to classify them as possible versus impossible. The ambiguity inherent to the visual inputs you are about to experience makes this task a feat worthy of the Man of Steel himself. **M**



## CHAMELEON CAMOUFLAGE

Chinese artist Liu Bolin uses his body as a canvas to disappear in plain sight. He and his team can spend days preparing for a photo shoot. Bolin has blended into landmarks, bookstores and even a bulldozer with the transformative ease of the Teen Titans shape-shifter Miss Martian, who can control her molecular structure to camouflage in any environment. Our eyes struggle to detect Bolin because his body paint reduces the contrast between the edges of his body and the background, subverting the same principles of lateral inhibition that help us find contours in other images.



## INVISIBLE GIRL

Sue Richards, aka the Invisible Woman of Fantastic Four fame, could manipulate light waves to make herself invisible. This superselfie of 18-year-old photographer Laura Williams of Cambridge, England, is fantastic in that our brain at first glance does not hesitate to perceive the young woman as partially invisible, instead of outright concluding that this is an impossible scenario.

We all have mental models of the human body, so we conclude that a girl is sitting behind the frame rather than that she is a disembodied head and limbs. Yet our visual system’s capacity to link the landscape in the background to the image inside the frame—which should reflect what is in front of, not behind, the girl—is even more powerful than our brain’s schemas of the human frame. This kind of perceptual stitching, which the German Gestalt psychology movement called “the law of good continuation,” trumps the brain’s assumptions about the shape of the human body. As a result, we imagine an invisible girl sitting behind an empty frame rather than a landscape reflected on a mirror.





## EVERYDAY SUPERHEROES

Artist Leandro Erlich's interactive installation *Bâtiment*, exhibited at the 2004 edition of La Nuit Blanche festival in Paris, consists of a detailed facade that lies flat on the ground. With a large, angled mirror facing it, the entire facade is reflected vertically, along with viewers, who can assume poses in which they appear to cling from windowsills by their fingertips or to climb walls Spider-Man-style. Much like Wenner's Spider-Man floor mural, this illusion all comes down to perspective, giving visitors an eerie, impossible experience.



## SUPERDAD

Italian photographer Giulia Pex has a series of Father's Day–inspired images entitled *Dad, you are my favourite superhero* that mixes drawing, illustration and photography to showcase her father's superpowers as she sees them. Artists learn that a line in a drawing or painting is often visual shorthand for the contour of an object, which we perceive using lateral inhibition.

In addition, neurons in the first stages of visual processing cannot distinguish between a solid form and an empty frame. As a result, the eye readily accepts line drawings despite the fact that they offer only the edges of a form. The extra effort required to interpret the image may actually make line drawings more compelling to our visual systems, holding our attention for a longer time. Here Pex tricks our line-finding neurons by drawing in a cape with just enough detail to make us see her dad's superhero status.

### FURTHER READING

- **Asphalt Renaissance: The Pavement Art and 3-D Illusions of Kurt Wenner.** Kurt Wenner. Sterling Signature (Sterling Publishing), 2011.
- **Supergods: What Masked Vigilantes, Miraculous Mutants, and a Sun God from Smallville Can Teach Us about Being Human.** Grant Morrison. Spiegel & Grau (Random House), 2011.
- **Adaptive Neural Coding in Frontal and Parietal Cortex.** John Duncan and Earl K. Miller in *Principles of Frontal Lobe Function*. Second edition. Edited by Donald T. Stuss and Robert T. Knight. Oxford University Press, 2013.
- **The Importance of Mixed Selectivity in Complex Cognitive Tasks.** M. Rigotti et al. in *Nature*, Vol. 497, pages 585–590; May 30, 2013.
- **Bâtiment.** Leandro Erlich. Image available on the artist's Argentine Web site: [www.leandroerlich.com.ar](http://www.leandroerlich.com.ar)
- **Dad, you are my favourite superhero.** Online portfolio by Giulia Pex: [www.behance.net/gallery/dad-you-are-my-favourite-superhero/9101573](http://www.behance.net/gallery/dad-you-are-my-favourite-superhero/9101573)