

# Notes of Ranvier

Interesting things from an overly-curious science nerd.

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## Neuromagicology: At the Intersection of Art and Science

We all know how the cameras in our phones are only so good. The photos look grainy and the colors washed out. Compared to the naked eye, phone cameras don't seem to compare.

Well actually, the camera in your smartphone is 2 1/2 times *better* than your eye! In other words, if the resolution on your phone camera is 5 megapixels, the processing power of your eyes roughly equates to about 2 megapixels. But then, how is it the world around you looks so much sharper, richer, and full of color than the photos on your camera roll? It's because you have something your phone can't even begin to emulate, the brain.

Don't believe me? Hold your arms straight out in front of you. Put the tips of your thumbs together with your index fingers pointed up towards the ceiling, so you're making mirrored L shapes, or one big U shape. Now close your left eye and look at the tip of your left index finger with your right eye. While looking at your left finger tip, focus your attention on your right finger tip. Did it disappear? If it didn't, wiggle it around a bit, and you'll see what I mean; you'll notice that it suddenly vanishes from sight.

That's because your right finger is sitting squarely in the blind spot of your right eye. There are no light-sensing photoreceptors there because that's where all the fibers that make up your optic nerve converge. It has been there all your life, yet you don't notice it until an illusion forces you to. You might have noticed that instead of your finger where it should have been, you just saw the wall or the computer screen or whatever your finger was in front of. What's going on here is the brain is "filling in" that blindspot with the stuff around it. Kind of like the [clone stamp](#) tool does in Photoshop.

### Illusions reveal the "supreme achievement of the brain"

For a long time, illusions have been thought to be the tools to reveal the limitations of the visual system and show where the brain "got it wrong." Neuroscientists Stephen Macknik and Susana Martinez-Conde see it differently. They think illusions really reveal something special, magical even, about the brain. "This is one of the supreme achievements of the brain," says Stephen, "The brain has actually evolved these processes that are illusory for the purpose of improving vision."

Not only do these illusions show us the nature of our visual experience, but they can also tell us something about consciousness. Consciousness is the first person experience of your life in the world, and it is home grown in your brain. Your senses interact with the outside world and send electrical signals to your brain to make sense of them, but when you look at these sensory systems, "you realize that the information going [to the brain] is really quite deprived." When so little information goes in, the brain has to fill in the details. The so-called conscious part of your brain comes from a separate group of neurons that takes information from your sensory and cognitive systems, your memories, your attention and other systems, and cobbles it together to make a simulation of reality. As Stephen puts it,

That simulation of reality is the only thing you've ever interacted with, it's not that the real world isn't out there--it is--but you've never been there. You've only ever interacted with this simulation of reality that's put together from sparse information from the outside world and the rest is essentially confabulated, just like that blindspot is a confabulation of sorts.

**From illusions to magic.**

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Stephen and Susana are very interested in how our attention and awareness, through the visual system, can be manipulated and what that manipulation says about the process--or confabulation--of consciousness. Illusions can certainly help, but they really only pertain to vision, not awareness and attention in particular. But while organizing a conference for the Association for the Scientific Study of Consciousness in Las Vegas, a little magic happened for Stephen and Susana.

They were brainstorming on how to generate public interest in the topic of consciousness, and they realized that they needed to study the artists of attention and awareness. But who would that be? "Finally it got through to us, Las Vegas spoke to us directly. It said, 'Magicians are the performance artists of attention and awareness.'"

Things took off from there. Stephen and Susana have worked with some great names in magic, like James Randi, Penn & Teller, and Apollo Robbins. Magicians, in the pursuit of bettering their art, have come up with some great theories about how the brain works that neuroscientists have yet to test in the lab. Having these theories before you start to research can also take years off the research process, and really help advance the field of awareness, cognition, and consciousness.

### The intersection of art and science

Susana focuses her research on eye movements. There are two different types of eye movements, saccades (which I talked about [before](#)) and smooth pursuit. To see the difference, hold out your thumbs in front of you and look at your right thumb. Now try to move your eyes in a line from your right to your left thumb, and you'll notice that you can't do it. Your eyes seem to "skip" along a line to your left thumb. That skipping from point A to point B is called a saccade. Now look at your right thumb as you move slowly to your left, and now you can follow it smoothly, hence "smooth pursuit." So we've just demonstrated to ourselves that smooth pursuit eye movements are involuntary. Now for the Magic.

Apollo Robbins is a professional thief. His act involves very close-range sleight of hand where he pick-pockets from people right before their eyes. Through his art, he noticed that if he moves his hand in a straight line from someone's pocket, people will look at where the hand is going to go, and then immediately back to the pocket through saccadic movement, and that this is a good way to distract someone, or trick them into thinking that he stole something from that pocket when he really didn't. But when he moves his hand in an arch people have to use smooth pursuit to follow his hand, and they don't look back to the pocket at the end.

Apollo's observations led Susana and Stephen to think that perhaps smooth pursuit and saccadic movements affect attention differently, and prompted them to do a [study](#). They found that with straight arm movement away from the pocket from which an item was "stolen," the attention of the thief-ee is directed through saccadic motions from the pocket to Apollo's hand, making the pocket the last place where the thief-ee had their attention, and thus they look back at it. But smooth pursuit eye movement directs attention to the hand as it moves away from the pocket, and there's enough time in between that the pocket isn't the next logical point of attention anymore.

And that isn't the only example, either. Magicians will "use humor in order to, basically, get away with magical murder. If they get people to laugh, their attention is suppressed." When you think about it, this might seem obvious, but there actually isn't any literature in neuroscience on the emotional modulation of attention. Studies on PTSD and anxiety get at the idea, few have looked at the effect of emotions other than fear on attention.

### Sleights of Mind

In their book, *Sleights of Mind: What The Neuroscience of Magic Reveals About Our Every Day Deceptions*, Stephen Macknik and Susana Martinez-Conde explore just that. They look at how magicians intrinsically understand the mechanisms of our attention and awareness and what their manipulation of those mechanisms can tell us about how our brain constructs our sense of reality from sensory stimuli.

Not only is this book very educational, but it's *fun!* *Sleights of Mind* is just as much about magic as it is about neuroscience. It's a great read for anyone, regardless of their background in science, who wants to know more about the brain and how it can be hacked. To order the book, and see some really awesome videos, illusions, and more, visit [sleightsofmind.com](http://sleightsofmind.com)!

Posted by [Cynthia](#) at 8:38 AM

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