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The Science of Magic

by Cathy Booth Thomas

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Gary L. Armstrong/St. Joseph's Hospital and Medical Center

Have you heard the story about the neuroscientists who were driving up and down the Las Vegas Strip looking for a convention venue when suddenly—while staring at 100-foot billboards of Penn & Teller, Criss Angel and David Copperfield—they realized that the magic shows of Sin City might hold secrets to the brain? It's no joke, even the part about the scientists becoming magicians themselves. Magic, it turns out, is helping researchers and doctors understand brain disorders such as autism and Alzheimer's disease.

Susana Martinez-Conde and Stephen Macknik were unknown researchers in 2005 when they set out to create some buzz around their research into visual neuroscience—what they call neuromagic. Think about Mona Lisa's smile. Why is it so enigmatic? Because our eyes trick us into seeing something that's not there. It's a visual illusion, a sleight of mind that bamboozles us. Driving along the Strip that day, says Macknik, the two realized that magicians are the masters of "attention and awareness," understanding instinctively how to trick the brain—even when we know we're being tricked. "You can look and not see," Macknik says. "That's what magicians rely on."

The two neuroscientists, who study consciousness, thought magicians could teach them a trick or two about perception, our own personalized illusion that feeds the brain. Our body is just the robot we drive around—and a poor one at that, Macknik says. While an iPhone camera has 8 megapixels (i.e., 8 million pixels), our eyes have only 1 million neuronal fibers. "Your brain takes this sparse information and builds this simulation of reality called consciousness by confabulating stuff from what you perceive," he explains.

The two met with James Randi, aka the Amazing Randi, who arranged a dinner in Vegas with Teller (of Penn & Teller), comic magician Mac King and illusionist Johnny Thompson, known as the Great Tomsoni. Crazyness ensued. "They start doing tricks immediately," Macknik says. "They are constantly trying to outdo each other." Thompson amazed his fellow magicians by dropping a handful of coins through the dinner table. Afterward, the scientists invited the magicians to their labs in the Barrow Neurological Institute at St. Joseph's Hospital and Medical Center in Phoenix. They also began learning tricks. "Fundamentally," Macknik says, "illusions are important inroads to the brain."

Much of Martinez-Conde's research focuses on eye movements. Meeting with the magicians at Teller's office in Vegas, she asked them to hold their thumbs in front of them and then look from one thumb to the other. The eye can't track smoothly from one to the other; it makes imperceptible jumps. Move one thumb over to the other, however, and the eye tracks smoothly. Listening to Martinez-Conde, Apollo Robbins, aka the Gentleman Thief, was floored. He was hearing the neuroscience behind the misdirection of hand movements in his pickpocket routine.

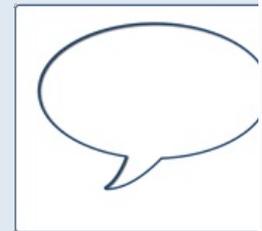
The Gentleman Thief uses humor, as do most musicians. Laugh and you miss the trick. Thompson, for instance, has a routine in which he changes his assistant's dress from white to red. First, he turns on a red light. It's not what the audience is expecting; it's too easy. He chuckles, then turns off the light—and in that moment, with the audience thinking the trick is over, the dress actually turns red. "Magicians can get away with magical murder," Macknik laughs. "It's the reason there are jokes in magic shows."

The whole issue of laughter, however, got Macknik and Martinez-Conde thinking about the connection between emotions and attention—which could be key in understanding how to treat the cognitive decline of people with Alzheimer's disease. "Memory is a big problem but mainly because it upsets people," Macknik says. Their current study, still secret, looks into how Hollywood movie directors

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manipulate emotion. "In neuroscience, there is a big controversy right now over what is emotion, where is it based?" Macknik says. "Yet it's fundamental to understanding our consciousness."

Magicians have another trick up their sleeves — what Martinez-Conde calls joint attention. When a magician looks at an object, his audience follows. (We were talking about this when Macknik yelled, "What's that out the window?" I turned to look. "Sucker," he said triumphantly. He had gotten my joint attention.) A child with autism would not be so easily tricked; they have trouble picking up joint-attention cues. That inattention could be important in evaluating those with autism, says Martinez-Conde.

Magic is a tiny part of their work these days, but the neuroscientists' 2010 book, *Sleights of Mind: What the Neuroscience of Magic Reveals about Our Everyday Deceptions*, has gone international and is a hit in Martinez-Conde's homeland, [Spain](#). Their contest, the Best Illusion of the Year Contest, is now in its eighth year. They passed the magicians' test at the Magic Castle in Hollywood and are now members of the Academy of Magical Arts. But they're not practicing much magic these days, says Martinez-Conde, laughing. "We were told not to quit our day jobs."

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