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The Neuroscientific Answer to 'How Did He Do That?'

By: Katja Brose

Keith Barry, skilled magician that he is, doesn't give away his tricks but he does give the audience a clue when he says "magic is all about directing attention."

How did he do that?

Neuroscientists have long known that attention plays a key role in perception, and yet, we still don't fully understand the details of how attention works and what neural mechanisms are involved. Only a small fraction of the information that comes in through our eyes is actually perceived by our conscious brains. Attention is the filter that directs what is most salient in our environment to our conscious awareness. Almost all magic tricks somehow take advantage of loopholes in attention. For instance, a key strategy for magicians taps into something which cognitive neuroscientists call "inattentional or perceptual blindness", our inability to notice an object or feature in a visual scene because attention is directed elsewhere. You have experienced this phenomenon yourself. Your brain is constantly bombarded with stimuli, and it is impossible to pay attention to them all. While your attention is focused on one thing -- neuroscientists call this the "attentional spotlight"-- your ability to perceive objects outside this focus area is compromised. Indeed, if we could record the activity of the neurons in your brain that track to the visual scene, the neural responses for those areas outside the attentional spotlight would be dampened. The magician takes advantage of this phenomenon. By distracting your attention with sly hand movements, lively banter, humor, or skillful shifts of gaze, he can move your "attentional spotlight," while manipulating the action elsewhere, all without your knowing it and indeed while you think you are paying close attention!

So, there you have it -- the neuroscientific answer to "how did he do that?" But, the fact that there is a logical, brain-based explanation behind the magician's tricks is not so surprising. The more interesting question is, if neuroscience can explain magic, can magic teach us anything about neuroscience?

At least some cognitive neuroscientists think so. For instance, cognitive neuroscientists Susanna Martinez-Conde and Stephen Macknik study visual perception and awareness in their labs but they've also developed a side venture in "neuromagic." (Check out their very cool book, Sleights of Mind: What the Neuroscience of Magic Reveals about our Everyday Deceptions.). Neuroscientists interested in visual perception have had a long standing interest in visual illusions and how they can "trick the mind," and we've learned a lot about how the mind translates an external visual scene into conscious perception by studying illusions. Martinez-Conde and Macknik make a case for similarly using magic as a tool to study cognition more broadly and perhaps even as an inroad to consciousness. A key goal for neuroscience is to understand the circuits and the neural mechanisms that mediate cognition. We still know relatively little about the details of the circuits and detailed mechanisms that underlie cognitive processes like attention and memory (and we know less about how these processes go awry in disorders of the mind). Collaborating with magicians like Penn and Teller to learn from them how the mind can be tricked and even learning to be magicians themselves, Martinez-Conde and Macknik then take some of these tricks back to the lab to study their neural underpinnings.

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-- Katja Brose

Magic shows us how easily the mind can be fooled but it isn't just visual perception and attention that the magician plays with, but also memory and decision making. Many magic tricks also take advantage of the ability of the mind to be readily distracted with false information. In thinking about Keith Barry's show and wondering "how did he do that" you will try to jog your memory, to remember where you got distracted and missed something, but, in actuality, because Barry skillfully used these same attentional sleights of mind to manipulate your memory systems, you will only be able to remember what he tricked you into seeing. Your brain is not like a computer that records and stores away every input. Memory is selective and also honed by attention. It's also well known that the memory is particularly malleable and the phenomenon of false memories is increasingly being viewed as a significant cognitive phenomenon with ramifications for all sorts of life events, big and small, from misplacing the keys to your car even when you are sure you knew where you put them to the high level of unreliability of expert witness testimonies. Why are some memories more labile and others more sticky? Attention may also play a role here.

Attention also intersects with how we make choices and decisions. For instance, the last trick of the show, with the cups and spikes, shows that decision making and even the perception of personal choice can also be manipulated. Berry again and again prodded the participant that it was his decision which cup to choose, but was it really his choice? Of course, the fact that decisions can be manipulated and that attentional mechanisms contribute should not be a huge

surprise -- we see this every day in advertising and media strategies that are designed to distract our rational decision-making minds.

By understanding the neural mechanisms for cognitive processes, like attention, memory and decision making and how they can be tricked, we can learn a lot how our brains work. We may also gain insights into conditions where the brain isn't working the way it should or situations where the brain even "tricks" itself, for instance, in neuropsychiatric disorders like schizophrenia, bipolar disorder, autism, anxiety/PTSD. By understanding how perception and cognition go awry in these disorders, with any luck, we may even someday be able to correct some of these conditions.

As a final thought, one might ask whether knowing how the trick is done takes away some of the magic and the awe that comes with suspension of disbelief. Is magic less magical because we can explain it with neuroscience? I would argue not. In science we see this time and time again -- it is those "ah-ha" moments of understanding and insight, the times when we finally figure out how something really works, that are truly magical.

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