FRIDAY... FULL OF GOOD CHEER

The science of magic

Rabbits out of hats, card tricks, levitation... Magic may encourage us to believe in the impossible, but scientists are researching the possibility of using the science behind these feats to help people with medical conditions.

By Carolina D'Souza , Lifestyle Features Coordinator, Friday
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If you've ever watched Criss Angel Mindfreak on television, you know what it's like to gasp, stare at the screen wide-eyed and slack-jawed with disbelief.

The magician has sawed himself in half, walked through glass windows, set himself ablaze, impaled himself on a wrought iron fence, made things disappear and performed mass levitation.

He is alive, of course. And he isn't the only magician who has lived through such seemingly dangerous illusions and stunts (minus camera subterfuge). Or the first to make us question our intellectual rigour.

David Blaine lived for seven straight days inside a glass coffin submerged in an open pit in New York City. He also stood in a hollowed-out block of ice in Times Square for almost 62 hours. David Copperfield made the Statue of Liberty disappear and performed a flying levitation, going as far as to carry a female volunteer à la Superman carrying Lois Lane.

Then there was the great Harry Houdini who escaped from chains, jail cells, ropes, handcuffs, straitjackets and submerged packing boxes with logic-defying ease.

While we watch such mind-boggling feats for entertainment, some people, mainly psychologists and neuro, visual and cognitive scientists, watch them for a more serious reason - research.

It's almost unbelievable. Why the sudden interest in the apocryphal powers of wands and hats? After all, these showy entertainers have been on the receiving end of accusatory fingers and tut-tutting. And their panoply of tricks has been questioned, suspected, impugned, even arraigned.

Now a red carpet is being rolled out - all the way from the stage to the medical labs. To whose benefit? Why have the protectors of our cerebral logic and reasoning deigned to acknowledge them thus?

The reason: to gain further understanding into human cognition. They postulate magicians can manipulate our attention and control our minds so well that their techniques should be studied for psychological and neurological clues. In this partnership, the two syncretic disciplines of magic and science are set to help each other for a greater good. Magic will teach science how it fools our brains and science will use this knowledge to learn more about how our minds work.

Turning tricks into research

Ten years ago, Ronald A Rensink, a psychologist and associate professor at the University of British Columbia (UBC) in Vancouver, Canada, was studying visual perception.

Magicians, he realised, know how to direct our attention, distort our perception and make us see what isn't there.

An example of the theory is the trick of the vanishing ball. It demonstrates how people often see things that have never taken place.

Here's how it works: a magician throws a ball up and down a couple of times. On

the final throw, he pretends to throw the ball when in fact he doesn't, instead concealing it in his hand. Surprisingly, people claim to see a ball leave the magician's hand, even though it never does.

This knowledge proved to be more than just intriguing for Rensink.

It helped him and his colleagues discover an important aspect of visual perception - we need attention to see change, and without attention, changes, even large and obvious ones, could go effectively "unseeable".

He says, "There was a close link between this effect [visual perception and focused attention] and the kinds of things magicians did to make things disappear." (He noticed the same effect in road safety studies where "a driver looked, but failed to see".)

Rensink spoke to a few magicians and learnt that they have considerable knowledge about attention. And ideas too - based on their study of magic - previously unknown to scientists. A collaboration between magicians and scientists was necessary to develop this link.

Magicians volunteered with alacrity to provide their insights. Many realised the value of their work beyond the stage. Frederic Sharp, Dubai-based French magician, is aware of this collaboration.

"Over the years we have developed techniques to control spectators' attention. These can help scientists understand elements of human cognition like perception and awareness for medicine and education. I can see why they want to study magic," he says.

Sharp specialises in close-up magic and performs at private, corporate events and trade shows across the UAE and in Europe. He is also the resident magician for the Manchester United Football Club. (To see his work log on to www.magician-dubai.com)

He believes magic is a highly advanced form of performing arts. "Magic is a combination of several scientific principles and methods. When we experience a magic trick or an illusion, unconsciously we look for an answer. I compare our knowledge to a chest of drawers. When the spectator sees a magic trick, he looks into his chest of drawers for an answer, but cannot find one. This leads to astonishment."

And this process of searching for answers and finding none defines magic. It's what makes magic - magical. If we deconstruct magic, we risk destroying it. Neurobiologists Susana Martinez-Conde and Stephen L Macknik, however, don't think so.

"If this were true, nobody since Copernicus [the Polish astronomer who was the first to propose that the sun was the centre of the solar system] could have enjoyed the sunset. On the contrary, deeper understanding leads to a fuller and more complete sense of the beauty of art and nature. Even though we know how magic tricks work, we are nevertheless manipulated and enthralled by a great magic trick - just like everybody else," they say.

Martinez-Conde and Macknik are laboratory directors at the Barrow Neurological Institute (BNI) in Phoenix, Arizona, US, where they study various aspects of visual, sensory and cognitive neuroscience.

Their research and outreach activities have been published in newspapers including The New York Times, The Wall Street Journal, The Chicago Tribune, The Boston Globe and New Scientist and their academic contributions have appeared in Nature, Nature Neuroscience, Nature Reviews Neuroscience and the Proceedings ofthe National Academy of Science among others.

For their research, they enlisted help from magicians. They say, "While many believe the technique should be kept secret, none of them, to our knowledge, think it should be kept from scientists studying the brain."

Still, the details of a magic trick can take away the sense of wonder, argues Rensink. He says care should be taken not to reveal the details so audiences may continue to enjoy the wonder and surprise. "If magic is approached this way, magicians and scientists can work comfortably together."

Research in the field is nascent. For now, validation comes from the largest academic society in the world - The Society for Neuroscience (SFN), a non-profit membership organisation of scientists and physicians founded in 1969. This month it hosted the premier presentation on the topic of 'Neuromagic' at their annual meeting in Chicago, attended by more than 30,000 neuroscientists.

The medical fraternity hopes to harness the knowledge privy to magicians.

Martinez-Conde and Macknik say, "Magicians manipulate our attention and awareness in front of us like taffy [candy] being twisted in a taffy-making machine. The techniques used are in many ways more powerful than what we can do in the lab."

To learn more about human cognition, scientists zeroed in on three areas of magic - the ability to control attention (misdirection), distort perception (illusion) and influence choice (forcing). Rensink says these three were selected because they

were common to both magicians and scientists.

Misdirection: now you see it, now you don't

Think of the disappearing coin trick, often referred to as the vanishing coin illusion. The spectator perceives that the magician transfers a coin from one hand to the other - with the coin then vanishing. In reality, the coin never changes hands; it is concealed secretly in the hand and remains out of sight.

Rather like the vanishing ball illusion, the coin trick proves what Rensink was speaking about earlier - the ability of a magician to control attention or misdirect. In a review titled Towards A Science Of Magic in a journal published by Elsevier, Rensink and fellow authors Gustav Kuhn and Alym A. Amlani say most manipulations are carried out at a normal pace. The common belief that magicians hide their methods by relying on speed is false. Rather, the success of an effect depends on misdirection so the audience doesn't notice how the trick was performed. (Kuhn is credited with studying the vanishing ball illusion.)

The authors found several rules of magic including "the audience will look where the magician is looking", "control can be achieved through repetition or off-beat moments" and "non-verbal signs such as body posture to manipulate the level of vigilance" useful in understanding visual perception. Rensink says, "Magicians can control our attention by showing something bright or big or moving. They can even send a person's attention to an object by pointing to it with their finger or looking at it."

Jamie Raven, a London-based magician knows this only too well. He was voted into the world-renowned Magic Circle, the premier organisation for magicians, at the first attempt. He also performed at Buckingham Palace during the Queen's 80th birthday celebration and for high-profile private and corporate clients and celebrities.

Raven is known for tricks that include borrowing $1 and turning it into a $100 note, and sealing an envelope behind a zipped compartment in his wallet.

He says, "The audience will look where I look and the human eye will always be drawn to a moving object. These rules allow for misdirection in the world in which I operate."

Such rules are sacrosanct for magicians. Body language is very important, says Sharp. "A movement of the head in a certain direction can help manipulate the spectator's expectation."

And it is certainly thrilling and frustrating to watch them spin your sense-making axis. When you see a good magician perform, "the laws of physics, probability, psychology and common sense - the four trusty compass points in your mental map of reality - are suddenly turned into liabilities," say Martinez-Conde and Macknik. "And with all your smarts, you can't imagine how it's being done. Magicians are the premier artists of attention and awareness, and they manipulate our cognition like clay on a potter's wheel."

Magicians, scientists have discovered, use several areas of knowledge to trick us from the more obvious presentation skills to the less obvious human psychology and cognition.

Illusion: rabbits from hats

Raven cannot turn a $1 into a $100 note, but he has the ability to make it look like he can. "If I could, I would be the richest man alive," he laughs. Magic is an anomaly, he says. "If you're good, no one will ever know how you do it. I will borrow a $1 note and show you my empty hands and rolled up sleeves. I will then fold the note, unfold it and change it into a $100. There will be no sign of the $1. I will then repeat the process and show you the original $1, which I will then return to you. You will never know how I do it."

The case is similar with illusions like levitation, rabbits from hats and making objects disappear in full view where the mind registers the impossible.

In the same review, Rensink and fellow authors write about two types of illusions - optical (physical factors) and cognitive (psychological factors). The former relies on intricate mirror combinations and perspectives to distort the true size of a box, for example, leaving plenty of room to hide a large object. Optical illusion also uses mirrors and special lighting to make an object appear and disappear or make one object morph into another. The latter (cognitive illusion) relies on sleight of hand to trick the spectator into seeing what isn't there.

In other words, magicians know how to use the discrepancy between our subjective perception and reality in a theatrical and dramatic setting to their benefit.

Their study sought to identify the parts of the brain that register these captivating events. The reason our mind registers the impossible, says Rensink, is connected with the way we see something based on expectation rather than reality.

Forcing: choose a card

When Raven performs a card trick he uses different methods to influence your choice or to make you think it is of your own volition. When you pick a card from a deck or simply think of one, he can predict your choice - much to your astonishment.

This ability to control choice is termed "forcing". Can Raven really do this? The answer is no. How does he do it then? Rensink and his colleagues looked at various mechanisms. First they categorised forcing into physical and mental force. Physical force, they said, is at play when you physically select a card from a shuffled deck. In this case, you operate with various assumptions like the deck contains 52 cards equally available for selection and that the magician has no control over them. A practiced magician will use sleight of hand to control the order of the cards to force a particular card upon you or add extra numbers of a certain card to increase the likelihood of that particular card being selected.

Mental force is used when a magician manipulates the presentation of the cards to favour a particular choice. Rensink believes the mechanisms underlying mental force offer scientists a new way of studying non-conscious processing. Raven works to construct a context that favours reflexive behaviour to influence choice.

He says, "If I'm performing a card trick and I know that the one you selected is exactly half way down, I want to take this out so I can put it somewhere else. Now I can't do it fast while you are watching my hands. However, if I talk to you, make you laugh for a few seconds, it gives me an offbeat moment where you let your guard down. I then have much longer to place it in your pocket without you noticing."

Raven must also convince you that he is fair. He says, "You will look for ways that I use to trick you. You will be suspicious of every movement."

Sharp is aware of the demands of close-up magic as well. He says, "Timing is essential when performing magic. We know when the spectator's attention is relaxed, and often design our tricks to create such moments. Certain tricks are difficult to perform when the spectators know what is coming. This however doesn't apply to all tricks and illusions. There are certain tricks I could perform over and over, and you still wouldn't know how I do it!"

The key, says Rensink, is the way magicians create appropriate assumptions and prevent the spectator from becoming aware that his choice was controlled.

"Forcing is one of the great mysteries of magic and is still unexplained by cognitive neuroscience. We can study the factors like timing, location, etc, that make this possible. Knowledge of these will then help us understand what is going on in the mind."

Scientific potential

Magicians know to deceive us; their knowledge can be a quarry of potentially valuable information. Scientists have yet to explore methodologies at work for several magic tricks like the "cut and restored rope trick" where a rope is cut in half and the two halves are magically reunited. Some principles magicians use - to orchestrate our attention for instance - can teach us how we orient our attention and explain why we often fail to see things.

The practical applications are immense. Rensink says, "Some of the findings can help treat vision problems. We would also be able to control attention more effectively in visual displays [in commercial capacity]." Does this mean neuroscientists will perform card tricks on patients? According to Martinez-Conde and Macknik, their interest is to discover the fundamental underpinnings of why card and other magic tricks work, and apply that understanding to improving existing therapies.

They say, "One cognitive process magicians manipulate is our spotlight of attention. Magicians have independently developed very powerful techniques to manipulate this spotlight and swing it around like a magnet pulls a compass needle. We can learn those techniques and translate them to improve focus during treatments for patients with cognitive decline or brain damage [Alzheimer's]. Or to improve focus during crucial points in our kids' classrooms. We could design therapies to enhance memory just as mentalists commonly do as part of their acts, and potentially combine them with drug therapies."

But has medical science found why magic works in the first place? Surely not because we are gullible? Or are we?

"In fact, we are," say the neurobiologists. "To navigate through our lives we hold a great number of assumptions to make quick and accurate choices without first researching every decision. Magicians take advantage of these assumptions. Magic works because humans have hardwired processes of attention and awareness that are hackable. By understanding how magicians hack our brains, we can better understand how we work."

And there is nothing magical about that.

The complete magazine

Friday