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The science of magic: it's not all hocus pocus

Think of your favourite magic trick. Is it as grandiose as David Copperfield's Death Saw, or is it as simple as making a coin disappear in front of your very eyes?

These two very different tricks have the same effect; they delight and astound, leaving the audience to ponder (usually unsuccessfully):

> *How did they do that?*

But while magic has entertained us for thousands of years, it also has a long and colourful history of informing areas of scientific research, from cognitive psychology to treatment of paralysis.

How could such a seemingly innocuous form of entertainment affect such diverse areas?

Uncovering magic's secrets

In 1893, French psychologist Alfred Binet managed to co-opt five of the country's most prominent magicians to help him understand illusions.

His interest in the development of cinema led him to record and view their performances frame by frame.

He was able to analyse the movement of the magicians as an animated sequence with the hope of understanding how audiences could be deceived by the magic performed right in front of them.

In his 1894 article La Psychologie de la Prestidigitation, Binet concluded that magical illusions were created by so many little optical tricks that:

> *to perceive them could be quite as difficult as to count with the naked eye the grains of sand on the seashore.*

A 2008 article by a group of research psychologists argued that it was time to acknowledge magic's influence on the cognitive sciences, opening a new field called the "science of magic".

In 2010, neuroscientists Stephen Macknik and Susana Martinez-Conde coined the term "neuromagic" in their book Sleights of Mind.

The pair published some of their research findings in Nature, co-authored with not one, but four of the world's leading magicians.

Like Binet more than a century before, they saw the value of working directly with magicians.

Perceiving blindness

Magic has finally emerged from the box labelled "entertainment" and now shines a light on one of the most perplexing areas of mind studies – perception.

Perception is key in many magic techniques. Audience members will follow a magician's hand when he or she gestures in a curved line – but not when the line is straight, to give just one example.

Scientific attempts to understand perceptual processes have largely relied on functional Magnetic Resonance Imaging (fMRI) – medical imaging techniques that identify brain activity through changes in its blood flow.

Scientists also study eye movements using head-mounted eye trackers to ascertain objects of visual focus.

But much of our visual perception cannot be understood as a direct fit between seeing something and that thing registering in our attention.

Looking but not seeing

Our everyday perception is littered with episodes that psychologists call "inattentional blindness" and "change blindness".

In other words, something happens in front of us but because our attention is elsewhere, we don't register having seen it.

Neurologically speaking, when change occurs gradually it is referred to as change blindness, and one of the best examples of this is British psychologist Richard Wiseman's colour card changing trick.

If the change occurs abruptly, it's called inattentional blindness.

An experiment by American psychologists Daniel Simons and Christopher Chabris is by far the most famous illustration of this, and won them the Ig Nobel Prize in 2005.

But while the colour card changing "trick" and Simons and Chabris' experiment aren't technically magic tricks, magic provides an arena for observing how our visual perception is often at odds with the objects and events happening before our very eyes.

Misdirection is a standard technique of the magician's palette and demonstrates the perceptual rift between looking at something and attending to it and it is this rift that fascinates neuroscientists and neuropsychologists.

Commonly thought to be about speed – isn't the hand quicker than the eye? – misdirection is actually more about leading us to focus only on a particular area.

When a magician throws a ball into the air and it seemingly vanishes, the trick works because the audience is following the magician's gaze – not his hand.

After really throwing the ball into the air numerous times and then simply performing the same movement in every way but without the ball, most people will see a ball fly into the air and disappear.

The magician has misdirected your gaze into following his and deployed a combination of inattentional and change blindness.

A neurological perspective

What we also learn from this neurologically is that implied movement stimulates brain functioning in much the same way as watching an actual movement.

That your gaze can differ from your attention is something that magicians have long exploited.

So now neurologists are looking to magic to help answer questions such as:

> *Why don't we see always something right in front of us?*
>
> *Why do our eyes more easily follow curved rather than straight gestures across space?*

Magic, which has exploited such aspects of the visual for centuries, offers us a framework to explore perception in an intriguing way, and the potential for understanding our perceptual system by investigating how magic exploits its blindness and gaps is enormous.

It has become a sophisticated research method and field helping to create more intuitive human-computer interface designs and advance rehabilitation techniques for people physically impaired by neurological conditions like strokes.

It is even being used to study problems in social responsiveness across the autism spectrum.

All we need to do now is convince more magicians to give up their secrets – but how easy that will be remains to be seen.

Filed under perception, magic tricks, neuroimaging, inattentional blindness, change blindness, psychology, neuroscience, science

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