

Conjuring Equivocations

Magicians hijack our brain's limited ability to deal with perceptual ambiguity

The renowned Slydini holds up an empty box for all to see. It is not really a box—just four connected cloth-covered cardboard walls, forming a floppy parallelogram with no bottom or top. Yet when the magician sets it down on a table, it looks like an ordinary container.

Now he begins to roll large yellow sheets of tissue paper into balls. He claps his hands—SMACK!—as he crumples each new ball in a fist and then straightens his arm, wordlessly compelling the audience to gaze after his closed hand. He opens it, and ... the ball is still there. Nothing happened. Huh.

Slydini's hand closes once more around the tissue, and it starts snaking



BY STEPHEN L. MACKNIK AND
SUSANA MARTINEZ-CONDE

Stephen L. Macknik and Susana Martinez-Conde are professors of ophthalmology at SUNY Downstate Medical Center in Brooklyn, N.Y. They are authors of the Prisma Prize-winning *Sleights of Mind*, with Sandra Blakeslee (<http://sleightsofmind.com>), and magician members of the Academy of Magical Arts (aka the Magic Castle) in Hollywood, Calif., and the Magic Circle in London.



Send suggestions for column topics to
MindEditors@sciencemag.com



Send suggestions for column topics to
MindEditors@sciencemag.com

around, slowly and gracefully, like a belly dancer's. The performance is mesmerizing. With his free hand, he grabs an imaginary pinch of pixie dust from the box to sprinkle on top of the other hand. This time he opens his hand to reveal that the tissue is gone! Four balls disappear in this fashion. Then, for the finale, Slydini tips the box forward and shows the impossible: all four balls have mysteriously reappeared inside.

Slydini famously performed this act on *The Dick Cavett Show* in 1978. It was one of his iconic tricks. Despite the prestidigitator's incredible showmanship, though, the sleight only works because your brain cannot multitask.

SPOILER ALERT: The next page reveals magic secrets! Stop reading unless you truly want to know more.

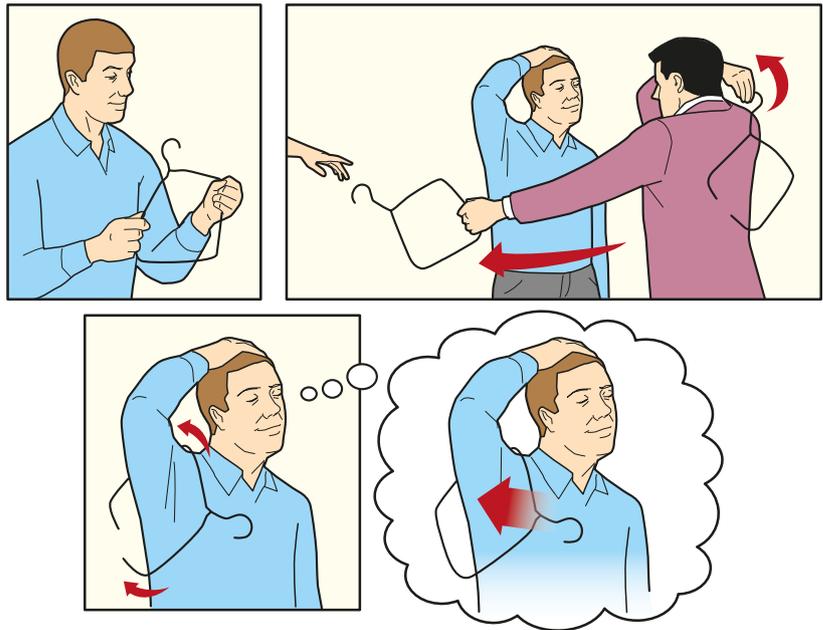
Slydini's trick relies on creating ambiguity and fooling you into resolving it incorrectly. When he reached into the box for "pixie dust," he used the same hand movement to drop each ball inside (having previously transferred it between hands). The pixie dust ploy justified what would have otherwise seemed like an unnatural action—a tactic we explained more fully in an article co-authored with magicians Teller, Apollo Robbins, James Randi, Mac King and Johnny Thompson. Teller refers to this kind of action as "a motion with a purpose."

The misdirection works because our brain automatically categorizes people's motions by interpreting their intentions. We see somebody push her glasses up the bridge of her nose and assume that the glasses had slipped. But a magician might use the same motion to hide something in her mouth. The motion is fundamentally ambiguous, although the action seems clear. It turns out your brain cannot conceive of an action having two simultaneous aims. So all Slydini needed to do was bias your perception to favor one interpretation (the hand is grabbing pixie dust) over the other (the hand is dropping a ball). Therein lies the magic. **M**

THE POWERS OF DARKNESS

Magician Paul Daniels has taken magical ambiguities to the sense of touch with his famous trick called The Powers of Darkness. Here a volunteer tests a regular wire coat hanger (*upper row, left*), and then an assistant secretly swaps in a trick hanger that has a gap in it (*upper row, right*). With the volunteer's eyes shut, the magician seems to pass the hanger through various parts of the volunteer's body (*lower row*)—although the audience can openly see that it is an illusion.

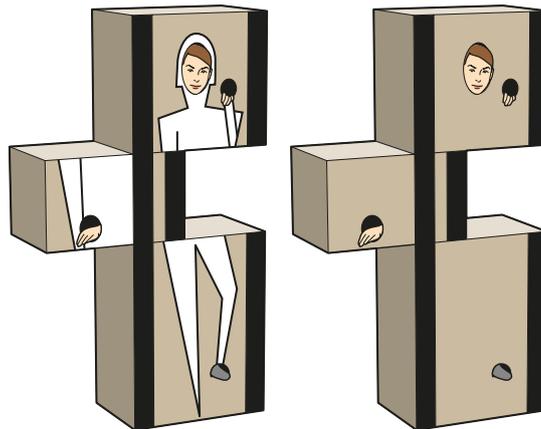
The trick works only because, having inspected the original hanger, the volunteer does not know it has been swapped for a gimmick and concludes that the solid hanger must have passed through his body magically. He closes the hanger's physical gap in his mind: a practical application of the good-continuation principle [see "The Zig Zag Girl" below] in the tactile domain.



THE ZIG ZAG GIRL

Magician Anthony Barnhart ("Magic Tony") is also a cognitive scientist at Carthage College. He has postulated that some magic acts rely on ambiguous illusions that take advantage of the so-called Gestalt laws of vision. In particular, the Gestalt principle of good continuation asserts that the visual system preferentially organizes aligned segments into continuous objects.

Barnhart has suggested that a popular magic trick, the Zig Zag Girl illusion, relies on such ambiguous visual cues. In the standard trick (*left*), an image on the side of the box shows how the woman inside the box must be magically segmented. Without the woman's painted silhouette (*right*), the illusion becomes less magical because other bodily contortions seem plausible.



MORE TO EXPLORE

- **Attention and Awareness in Stage Magic: Turning Tricks into Research.** S. L. Macknik, M. King, J. Randi, A. Robbins, Teller, J. Thompson and S. Martinez-Conde in *Nature Reviews Neuroscience*, Vol. 9, No. 11, pages 871–879; November 2008.
- **The Exploitation of Gestalt Principles by Magicians.** Anthony S. Barnhart in *Perception*, Vol. 39, No. 9, pages 1286–1289; September 2010.
- **The Put-and-Fetch Ambiguity: How Magicians Exploit the Principle of Exclusive Allocation of Movements to Intentions.** S. Van de Cruys, J. Wagemans and V. Ekroll in *i-Perception*, Vol. 6, pages 86–90; April 2015.