

Invite the entire audience to try to communicate the chosen card's identity to you telepathically. After some intense concentration, you successfully announce the card in question.

Top 5 Reasons to Like Mathematical Card Tricks

Colm Mulcahy
Spelman College
colm@spelman.edu

Reason No. 5: Laundry Lists are Fun (Socks Appeal)

Our first effect is hard to beat for audience participation: up to ten people can join in the fun. Minus the socksual connotations, it has a long history.

Effect: "All of us have had the experience of losing socks while doing laundry. Some of us lose a sock every time; it's baffling. Then we end up with all these odd socks! There is a simple solution of course, that only a mathematician would think of. As long as you have an even number of odd socks, you can define your own pairs." Take out a deck of cards, and hand out for shuffling.

"Laundry services in hotels, of course, don't have this problem, they always seem to get it right. I think I've figured out their system. I'm going to lay out ten pairs of socks here—I never said they matched perfectly, in fact all of them are made up of loners left over from previous relationships." As you speak, take the deck back, and count off twenty cards. Deal out this packet in a haphazard manner into face-down pairs, occasionally flashing card faces as you proceed, perhaps commenting on the odd matchings. Then turn away, and invite up to ten audience members to each peek at a different pair, and note both cards. "It's important that you be able to recognize your own socks later, so remember what they look like."

Have one person gather up the pairs in a random order and hand you the packet as you turn back. "Okay, it's time to do the laundry! It looks like I have a full load of socks today." Repeatedly cut the cards as you speak. "Round and round they go. I'm one of those people who doesn't believe in spin-drying, so I'll lay them out here to dry instead." Deal the cards out face down, one by one, in what once again seems to be a haphazard fashion, to form a rectangular array.

"I have four lines of socks here, with five socks in each." Turn all of the cards face-up, and remark, "I think they are dry

already." Now ask each person in turn to tell you in which line(s)/row(s) they see their socks/cards. As each person reveals their lines/rows, you pick up their socks/cards and return them.

Method and Mathematics: Proceed exactly as above, but note the bottom cards in a few of the flashed pairs when you first lay out the cards. As you do the laundry, stop cutting once you see one of your noted cards on the face of this packet: now you can rest assured that the packet consists of the ten pairs in some order.

The secret is in your second dealing: despite appearances, it is far from random. First, note that there are ten ways to choose two rows from four: six without repeating a row, and four with repeats. Second, there are many four by five arrays consisting of ten pairs of objects with the property that each of the possible ten "row pairs" determines exactly one of the pairs. One choice of some vintage is obtained by lining up the words RIDER, HOODS, CINCH, TENTS in four rows, or use the augmented symmetric matrix to its right.

R	I	D	E	R	A	E	F	G	A
H	O	O	D	S	E	B	H	I	B
C	I	N	C	H	F	H	C	J	C
T	E	N	T	S	G	I	J	D	D

As you deal out the pairs of cards, place them so as to cover pairs of letters in this "virtual array" in any order you like. You must mentally superimpose the array on the table for guidance! For instance, you could first deal a pair of cards to cover the two I's, then another for the T's, and so on, until you have the full array. Only then do you turn the cards over row by row, to conceal the fact that there was a method to your dealing. The rest is easy: if one person says their cards are in the first and second rows, they must be the cards in the D positions, and if another says both of their cards are in the last row, they must be the cards in the T positions.



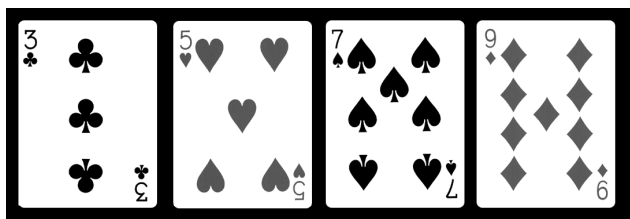
Source: Similar effects, using various words, have been in circulation for at least sixty years. This trick can be repeated if you lay out the pairs in a different order, and of course the row order can also be varied.

Reason No. 4: Audiences Enjoy Being Dazzled with a Little Geometry (The Klein 4 Card Trick)

Our next *little* trick involves four key cards, one of which has as its symmetry group the Klein 4 group K_4 of a rectangle.

Effect: The top cards from a shuffled deck are openly mixed thoroughly. One card is selected and noted by a volunteer, before being replaced. These four cards are thoroughly lost in the deck, yet you find the chosen card with no hesitation.

Method and Mathematics: Riffle shuffle all you want, while retaining these four prearranged cards on the top in any order: 3♣, 5♥, 7♠, 9♦. You must remember those: the suits are in the standard CHaSeD (Club Heart Spade Diamond) order. The key to this trick is symmetry: ignoring the pips in two corners, the 9♦ exhibits left-right, up-down and 180° rotational symmetry (so that together with the identity map, its symmetry groups is K_4), whereas the other three cards only have left-right symmetry (and hence a two-element symmetry group). As a result, for each of 3♣, 5♥, and 7♠ you can tell at a glance whether they are the “right way up” or “upside down.”



Ensure that these three cards are oriented the same way on the top of the deck at the outset. Take off the packet of four special cards—after the shuffling which does not disturb them, and mix them repeatedly, before inviting the somebody to choose one and note it. The four cards may be inspected if the volunteer wishes. Before the card is replaced in the packet, discreetly reverse the orientation of the remaining three cards. Place all four cards in the middle of the deck, and do some more riffle shuffling—being careful not to alter the orientation of the cards. Finally, fan through the cards’ faces, and look carefully at the 3♣, 5♥, and 7♠. If one of them is oriented differently from the rest, then it’s the chosen card. If they all point the same way the chosen card was the 9♦.

This trick can be done using any easily remembered collection of $n - 1$ so-called “pointer cards” (in most standard decks,

there are 22 such cards), and 1 non-pointer. If you do not encourage the volunteer to inspect the cards, you could use 3♥, 4♥, 5♥, 6♥, 7♥, for instance.

Reason No. 3: You Like a Challenge (Third Time Lucky)

The effect below dates back to the early 1920s, and shows that you can sometimes have the deck shuffled freely after a card has been chosen and replaced, yet still find that selection quickly. This is one of the basic secrets of card magic: simple shuffling often does a very poor job of randomizing a deck!

Effect: The deck is shuffled repeatedly, then given to a volunteer, who picks a card, places it on top, cuts the deck a few times, riffle shuffles, and then cuts the deck again. Taking the cards back, you glance through them, and then cut and shuffle. The volunteer is asked what card was chosen, and you promptly turn it over.

Method and Mathematics: Start by peeking at the top and bottom cards of the deck; remember these two key cards. Riffle shuffle while keeping these cards in place, and proceed as described above. When you get the deck back, the chosen card is between the two key cards. It may not be alone, but if it is, cut so that it is on top. Once the card is named, simply turn over the top card. If two cards are between the key cards, remember them both, and cut between them. Once the card is named, turn over the top card if appropriate, or turn over the entire deck. Of course, having the card(s) you want at the top (and bottom) gives you the freedom to do additional shuffles if you are careful.

In the (surprisingly unlikely) event that there are three cards between the key cards, then remember them all. Cut so that two are on top and one is on the bottom. Put the deck behind your back and place the top card in the middle of the deck, face up. Proceed as before unless the named card is the one you just flipped over, in which case you have a minor miracle on your hands.

If you are unlucky enough that there are more than three cards between the key cards, you will have to improvise a bit! One “out” is to cut all of the suspects to the top, remembering their order, and then place the deck behind your back. Once the card is named, you quickly cut it to the bottom while bringing the deck into view. Considering that officially you know nothing, your audience is likely to be impressed by any such revelation.

Source: This is basically “A New Card Discovery” by Charles Jordan in the compendium of his tricks by Karl Fulves.

Reason No. 2: Complementary Card Effects Always Make a Good Impression (Two Obvious)

This offering involves two volunteers, and while it requires some advance set-up, it's a puzzler to most audiences. The mathematical concept is simple: the idea of a not-so-obviously partitioned set.

Effect: The deck is shown to be well mixed, and is split between two volunteers, who are encouraged to shuffle further. Each volunteer now peeks at the top card of their pile and memorizes it, before exchanging top cards and shuffling again. Finally, the two piles are recombined, and the cards cut several times. You take the deck back and fan it publicly, rapidly pulling out two cards and placing them face down on the table. Have the two selections named and invite the volunteers to turn over the cards; they match.

Method and Mathematics: This trick would be very easy to do if one volunteer got all red cards and the other all black cards, and this was the way this trick was originally performed. The selected cards would break these runs in the reassembled-and-cut deck you look through. However, this would necessitate your being the only person who got to see the card faces.

We suggest dividing the deck into the set of primes (2, 3, 5, 7, J, K) and the complementary set (A, 4, 6, 8, 9, 10, Q), regardless of suit. Note that the Aces are lumped in with the composites; keep two of them with the primes if you want an even deck split.

Source: This is modified from an effect in John Scarne's classic 1950 book "Scarne on Card Tricks."

Reason No. 1: Magic Spells and Telepathy Go Well Together (A Wonderful Effect)

Effect: Have a volunteer select any nine cards from the deck, setting the rest aside. If you can do this without drawing attention to the fact that nine cards are involved, all the better. This packet is shuffled freely while you turn away. Ask the volunteer to look at and show around the third card in the packet, and then replace it. Now direct the silent spelling out of the card's name, one card of the nine being moved for each letter. Finally turn back, take the cards, shuffle them, and place on the table. Invite the entire audience to try to communicate the chosen card's identity to you telepathically. After some intense concentration, you successfully announce the card in question.

Method and Mathematics: Each card name consists of three words. The spelling proceeds for each of these words separately as follows: cards are dealt from the top of the packet onto a pile on the table, one card for each letter in the word in

question, and *at the conclusion of this spelling*, the remaining cards in the hand are dropped on top of the pile of the table, thus forming a new arrangement of the packet of nine cards. Each spelling reverses the order of some of the cards, and this is what makes the trick work.

For instance, if the chosen card is 7♣, the volunteer spells out S-E-V-E-N while dealing five cards into a pile, then drops the remaining four cards on top of these, then spells O-F, dealing out two cards, and dropping the remaining seven cards on top of these, and finally spells C-L-U-B-S, dealing out five cards again before dropping the other four cards on top. It is a very good idea to demonstrate this spelling technique first, before you turn away, *using ten or more* cards borrowed from the rest of the deck, and using a different card, perhaps the second one, as the chosen one.

When your volunteer has completed the actual spellings for the selected card, turn around and take the cards back. Shuffle casually and comment that you had no control over which cards were used, or which of those was chosen (the second claim is not quite true!). Remind everybody that the names of the cards vary in length a great deal, from short ones like 10♣ (ten letters in total) to long ones like Q♦ (fifteen letters). Actually, you only cut the cards as you speak, running off individually if necessary, until the fifth from the top (or bottom—it's the middle card in a packet of nine) is on the bottom. Peek at that card before giving the packet some genuine shuffles.

It's an easy and fun exercise to check why the third card from the top always ends up in the middle. Stressing the variable length of the card names seems reasonable, but it's pure misdirection: the individual word spellings/card reversals result in the chosen card being in the middle after the first two words have been spelled, and the third spelling does not disturb it further!

Source: The wonderful spelling principle used here is the creation of Jim Steinmeyer, and is included with his permission. It first appeared in *MAGIC Magazine* (May 1993), and can also be found in Steinmeyer's recent book *Impuzzibilities*. For a repeat performance, you can suggest that the volunteer deliberately lie about the name of the card while spelling. It's also easy to conceal the fact that the chosen card must start in the third position: have the volunteer choose the top card instead, after shuffling, then put the cards behind your back under the pretext of getting a tactile impression from the chosen card, and then transfer two cards from the bottom to the top before the dealing begins. It's worth noting (and proving) that if k , s , t are three numbers such that given k cards, the one in position s always ends up in position t when the above spelling principle is applied, then $k = 9$, $s = 3$ and $t = 5$. This trick is truly unique! ■

