



The 21 card trick

Repeating the trick:

1. Select 21 cards (any cards, doesn't matter)
2. Choose a card.
3. Memorise the card
4. Shuffle the card back in to the deck of 21 cards.
5. Divide the cards in to 3 piles. It is important you deal them 1,2,3,1,2,3,1,2,3.... Etc not 111
6. Identify your card.
7. Pick your cards back up, face down, so that the pile with your card in it is the middle pile.
8. Repeat the process of dealing out the cards.
9. Identify your card again.
10. Pick your cards back up, putting the pile of cards that contained your card in the second pile again.
11. Repeat the process once more of dealing out the cards.
12. Find the pile with your card, and once more collect the piles so the pile with your card is the second pile.
13. Now deal the cards out face up. Your card will be the 11th card.

Understanding the trick:

Repeat the trick to answer these questions (you may want to deal identified cards face up to see what happens with the mechanics of the trick).

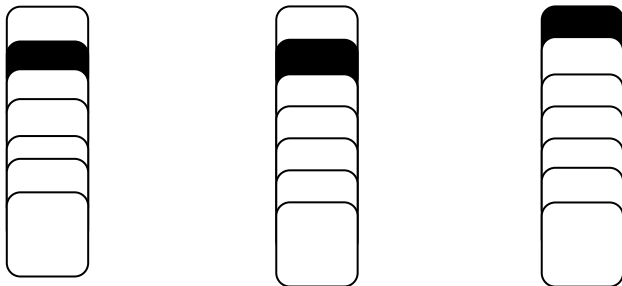
1. The first move is to place the selected pile of cards as the second pile you collect. What positions could your card be in now? (top of the deck = 1st, last card = 21st).

2. Repeating the same process, what are the possible positions now? It should depend on whether your card is in the left, central or right pile. Can you explain the 3 different scenarios?

3. Repeating the process for the final time, how do you now know your card is in the 11th position?

4. Could you collect the piles in a different order on that final time? Where would your card be if you placed the pile as the top or bottom pile instead?

5. We describe the trick as collecting the piles in order 2,2,2. We are now just going to consider the first two pile placements, so in this scenario 2,2. After 2,2 we know that the cards are in position 10,11,12 which are 4th in each column after dealing out the cards for the final time. However, if we chose 2 and then 1 the cards would be in position 3,4,5 which when dealt out would be 2nd, 2nd and 1st.



Fill in the table below, thinking about where the cards would be after the first two iterations of the trick. You probably want to carry out the card collection to start with, although you may then progress to working it out mentally.

Position of piles	Possible positions after choices	Column positions	Same number?
1,1			
1,2			
1,3			
2,1	3,4,5	2,2,1	N
2,2	10,11,12	4,4,4	Y
2,3			
3,1			
3,2			
3,3			

Why is it easier to carry out the trick if the cards are in the same column position the third time of dealing?

6. The card trick is carried out with 21 cards. The final placement of the cards depends on the remainder when you divide by 3, known as modulo arithmetic. What might be a better number of cards to start the card trick with rather than 21? Why?
