When is a pigeon smarter than a math professor?

(Or, An Intro to Probability, Sort Of)


LET'S
MAKE
A
DEAL
with our host
Monty Hall

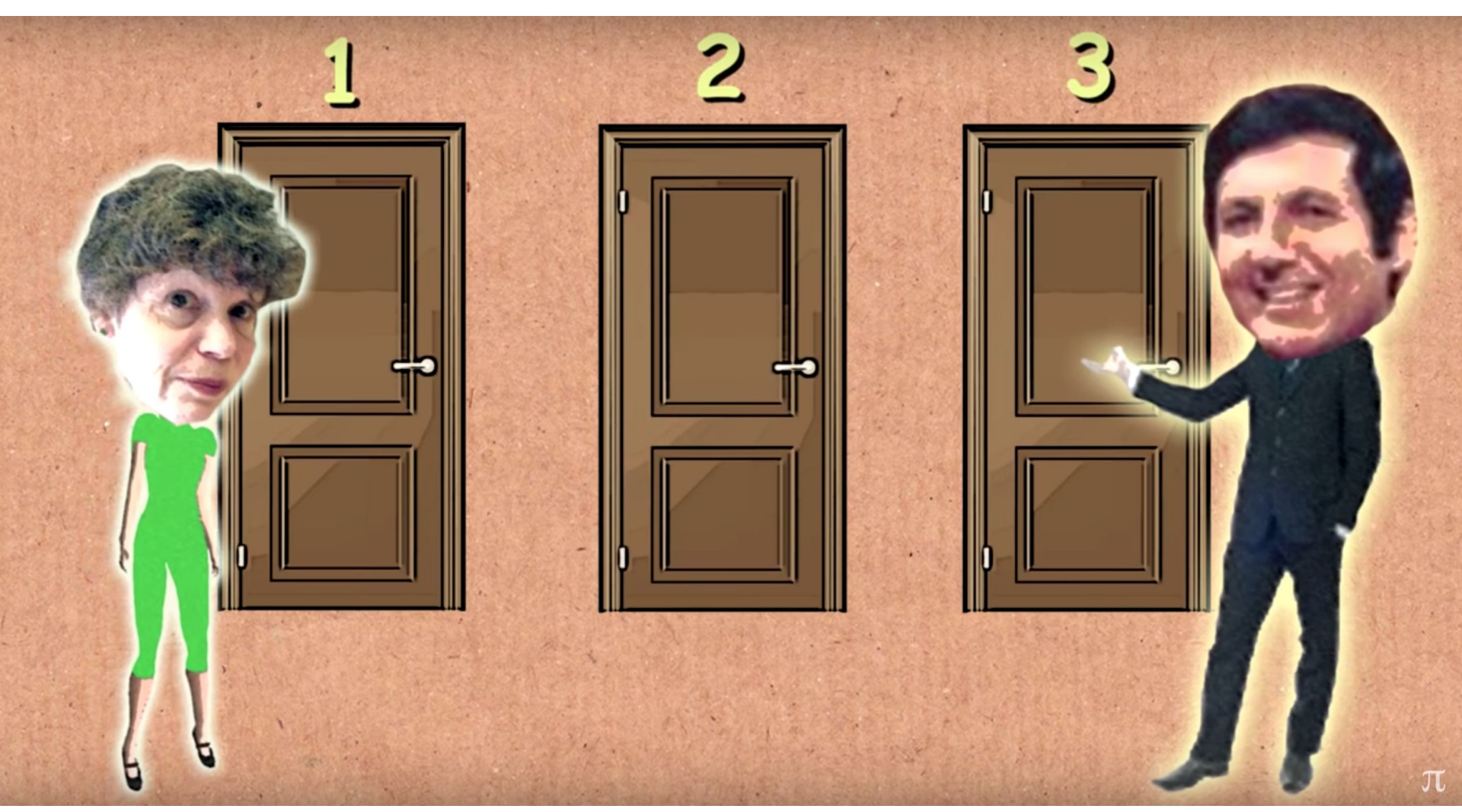

1
2
3

The Monty Hall Problem

Marilyn vos Savant

In September of 1991 a reader of Marilyn Vos Savant's Sunday Parade column wrote in and asked the following question:

"Suppose you're on a game show, and you're given the choice of three doors: Behind one door is a car; behind the others, goats. You pick a door, say No. 1, and the host, who knows what's behind the other doors, opens another door, say No. 3, which has a goat. He then says to you, 'Do you want to pick door No. 2?' Is it to your advantage to take the switch?"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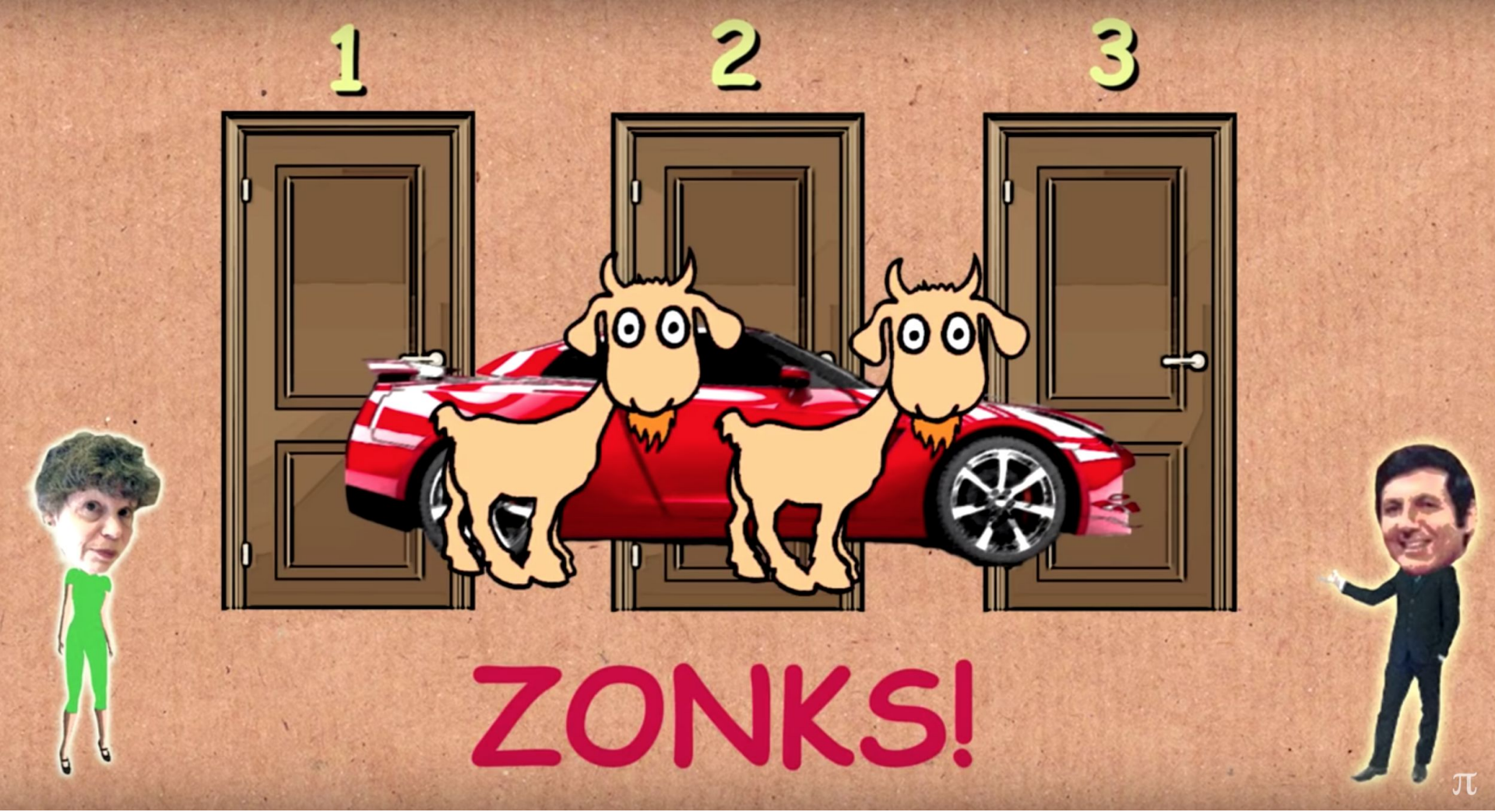
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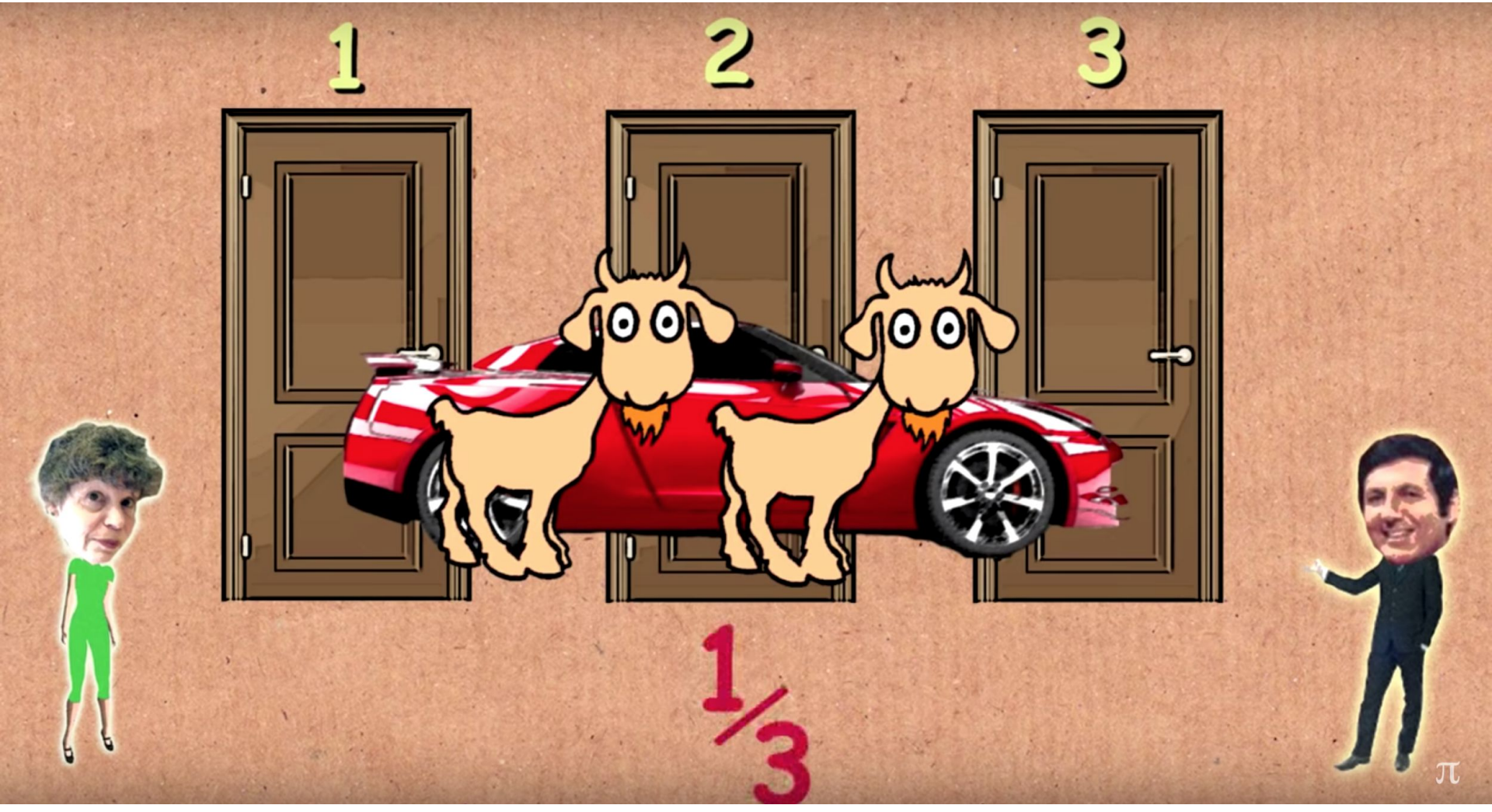
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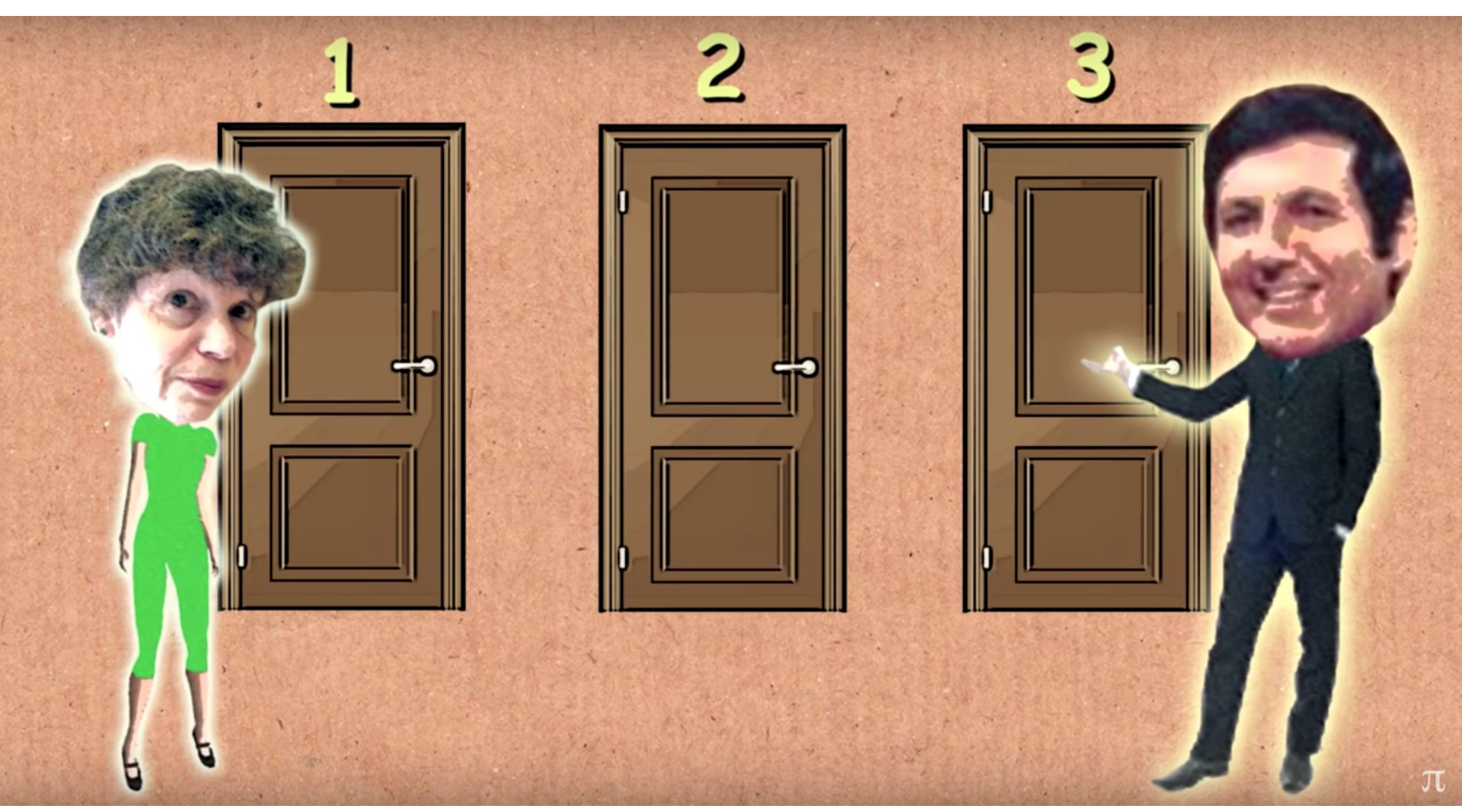
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Now that a goat has been revealed...

- What is the probability of picking a car behind door 1?
- What is the probability of picking a car behind door 3?
- Should you switch doors?

- Is it ½? Or……

Is the probability of getting a car 1/2 ?
It sure seems like it!

Should you switch doors?
It doesn’t look like it matters!

Let go back to the reader's question:

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According to Marilyn - Yes, you should switch!

But she got a lot of letters…..

You blew it, and you blew it big! Since you seem to have difficulty grasping the basic principle at work here, I'll explain. After the host reveals a goat, you now have a one-in-two chance of being correct. Whether you change your selection or not, the odds are the same. There is enough mathematical illiteracy in this country, and we don't need the world's highest IQ propagating more. Shame!
Scott Smith, Ph.D.
University of Florida

May I suggest that you obtain and refer to a standard textbook on probability before you try to answer a question of this type again?
Charles Reid, Ph.D.
University of Florida

I am sure you will receive many letters on this topic from high school and college students. Perhaps you should keep a few addresses for help with future columns.
W. Robert Smith, Ph.D.
Georgia State University

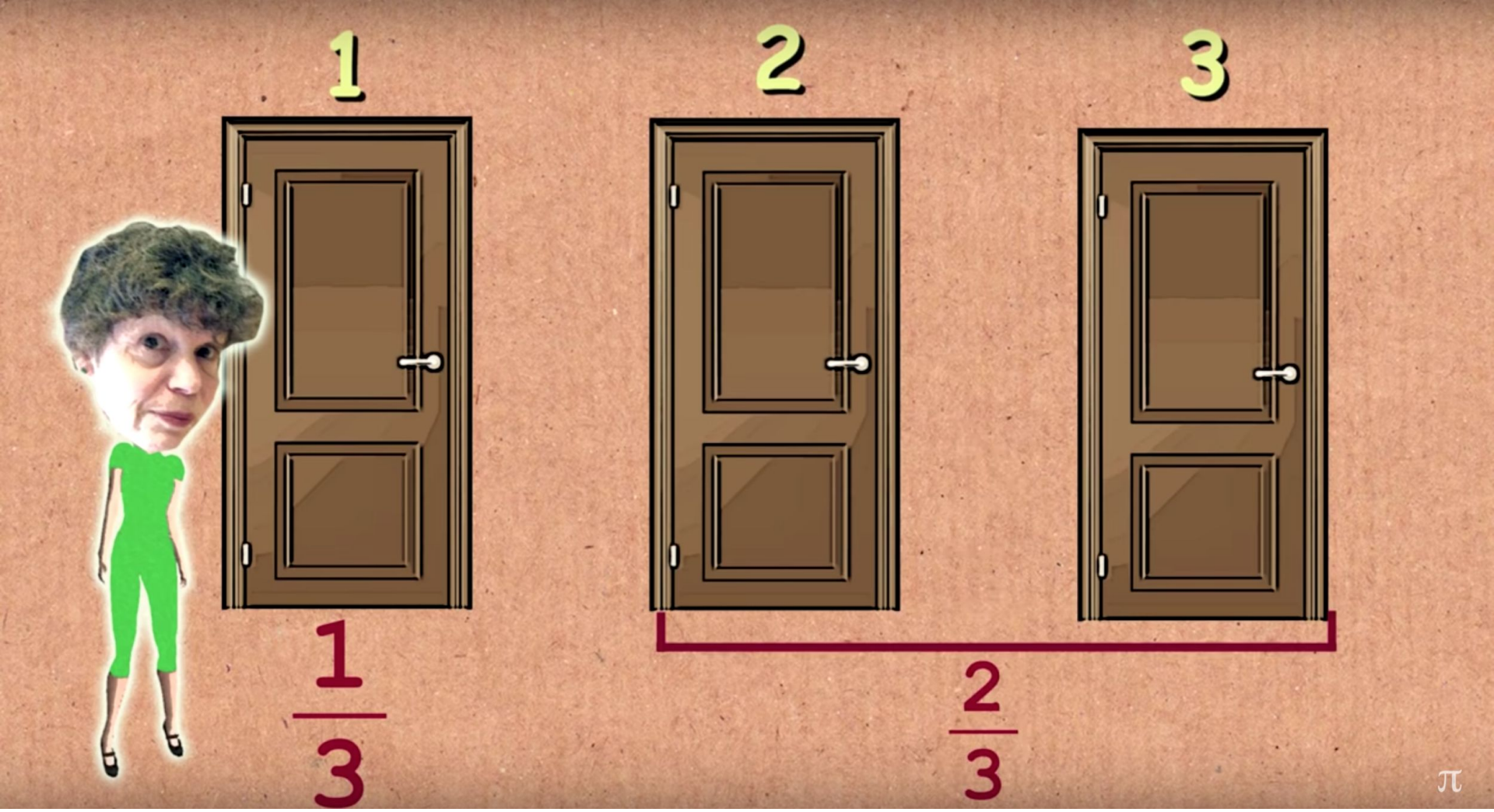
So what's the right answer?

Marilyn vos Savant's Answer

Yes; you should switch. The first door has a 1/3 chance of winning, but the second door has a 2/3 chance.

Here's a good way to visualize what happened. Suppose there are a million doors, and you pick door #1. Then the host, who knows whats behind the doors and will always avoid the one with the prize, opens them all except door #777,777. You'd switch to that door pretty fast, wouldn't you?

So, why is this?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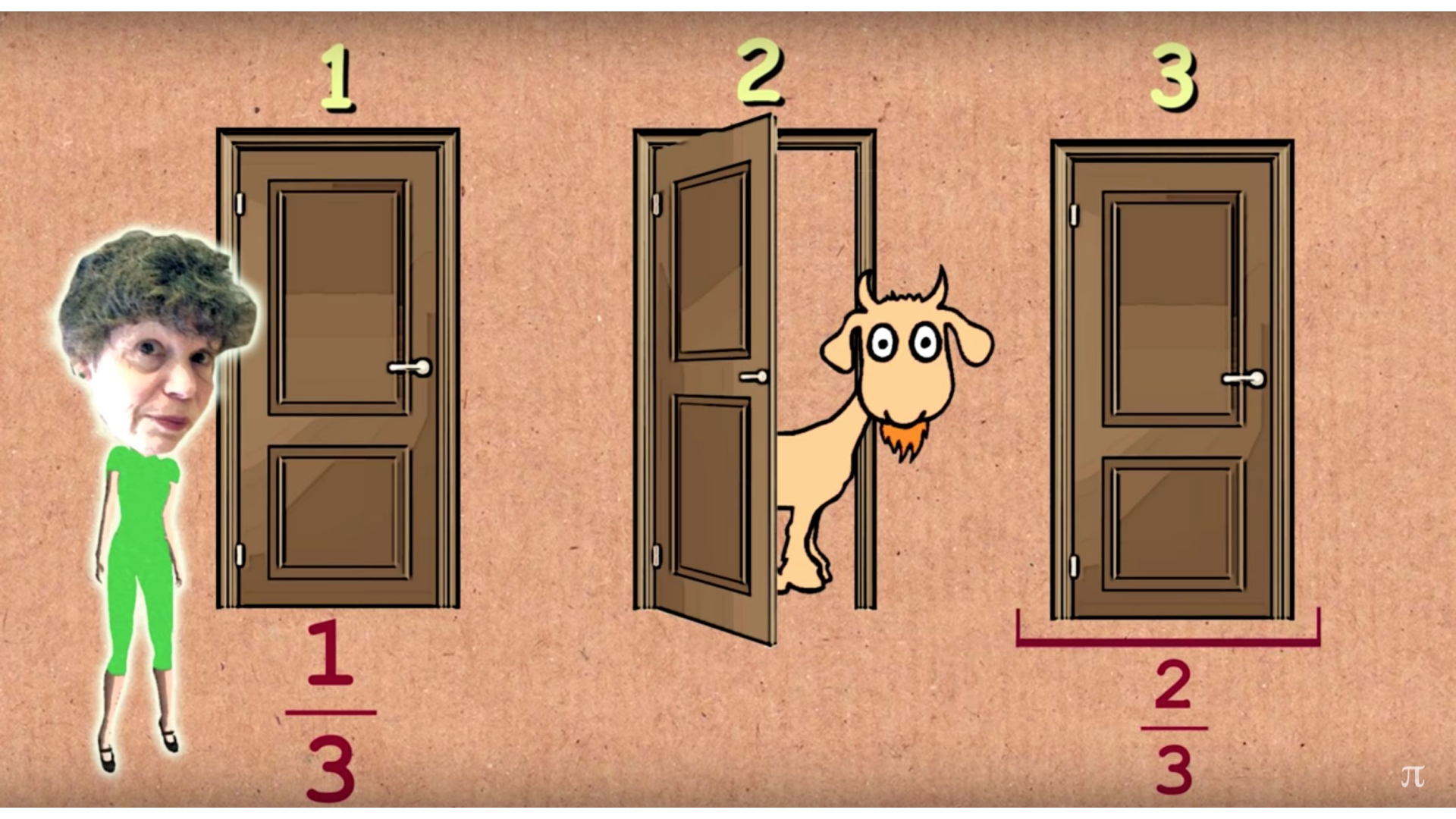
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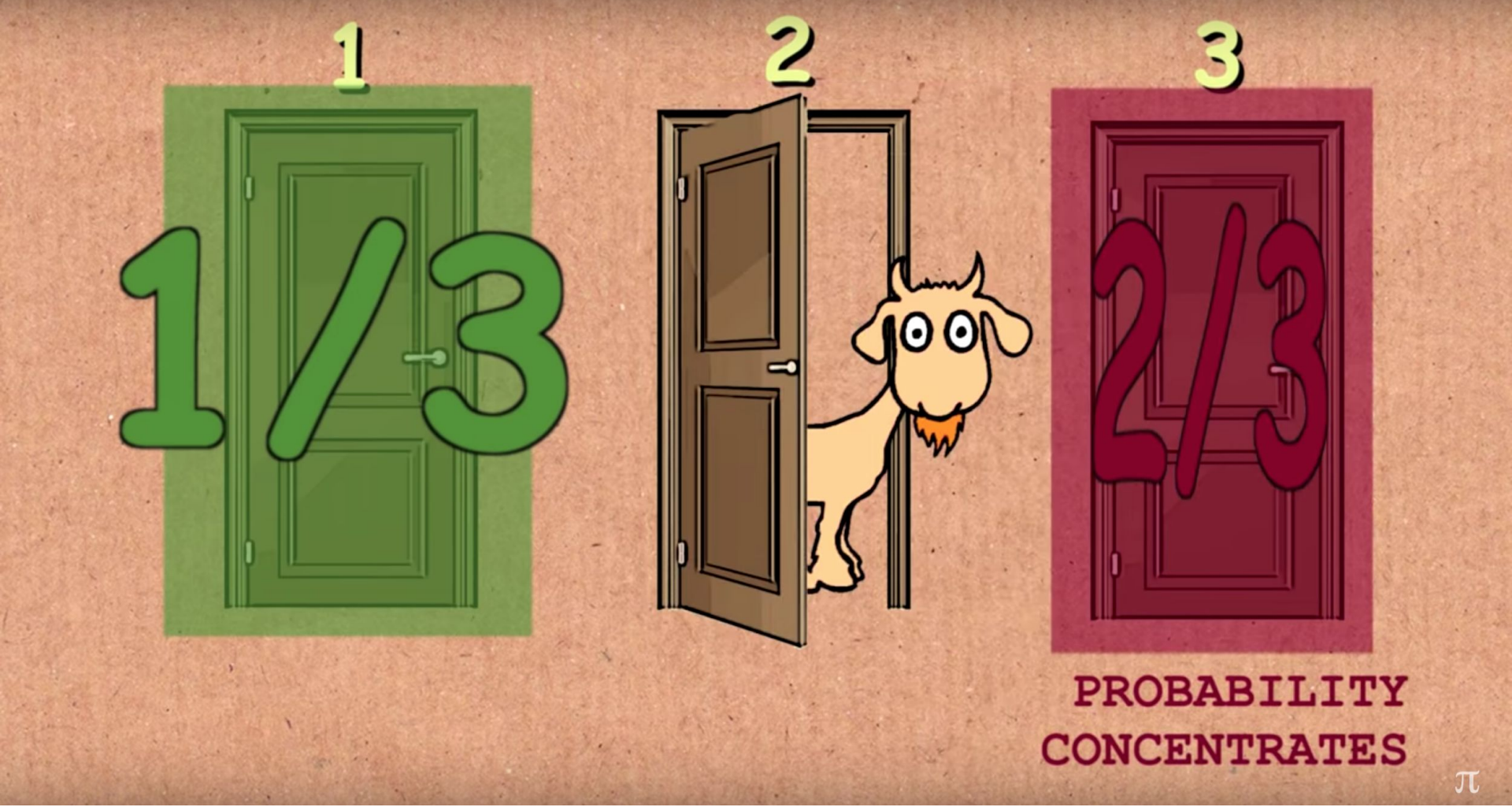
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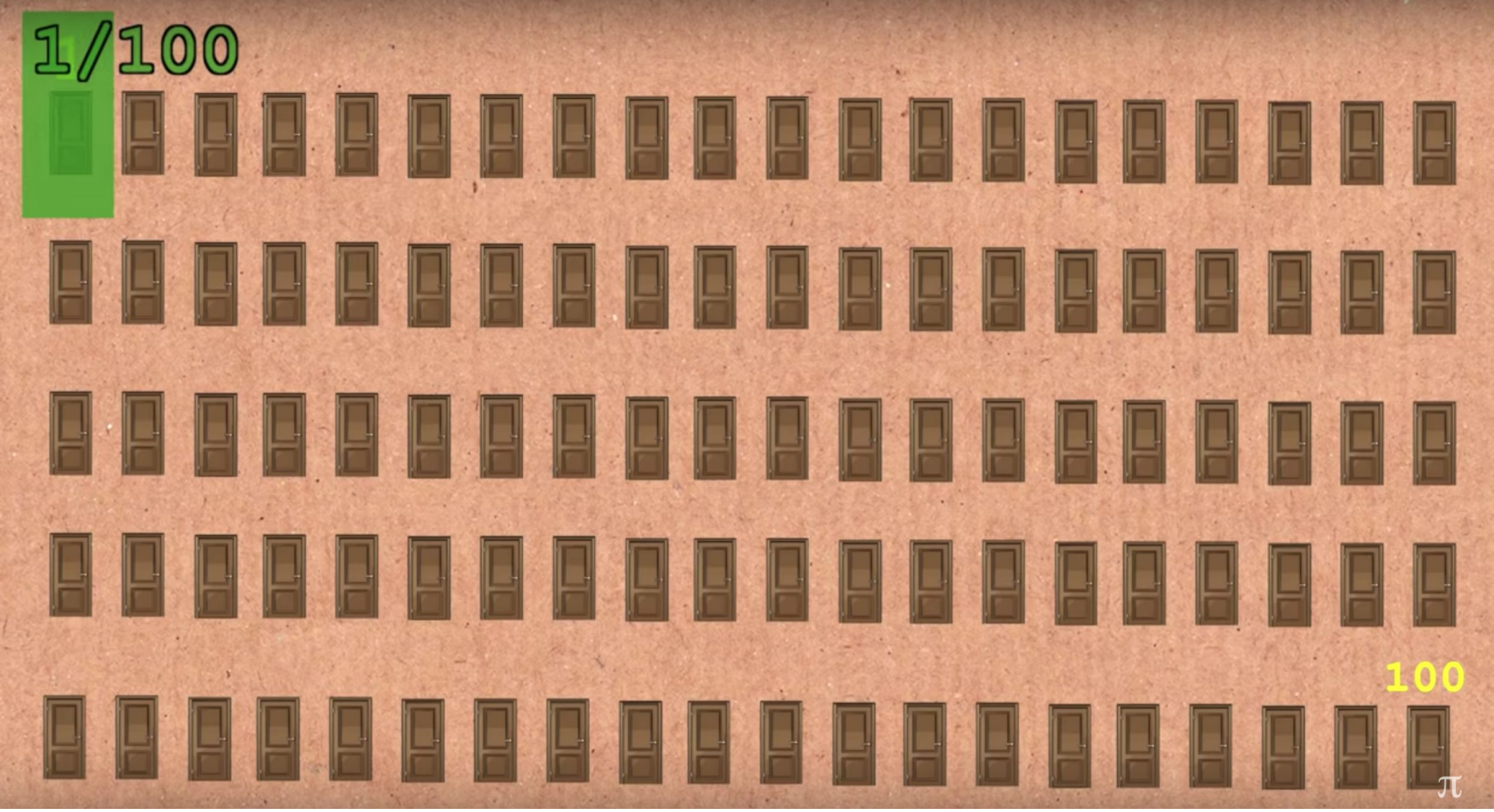
PROBABILITY
CONCENTRATES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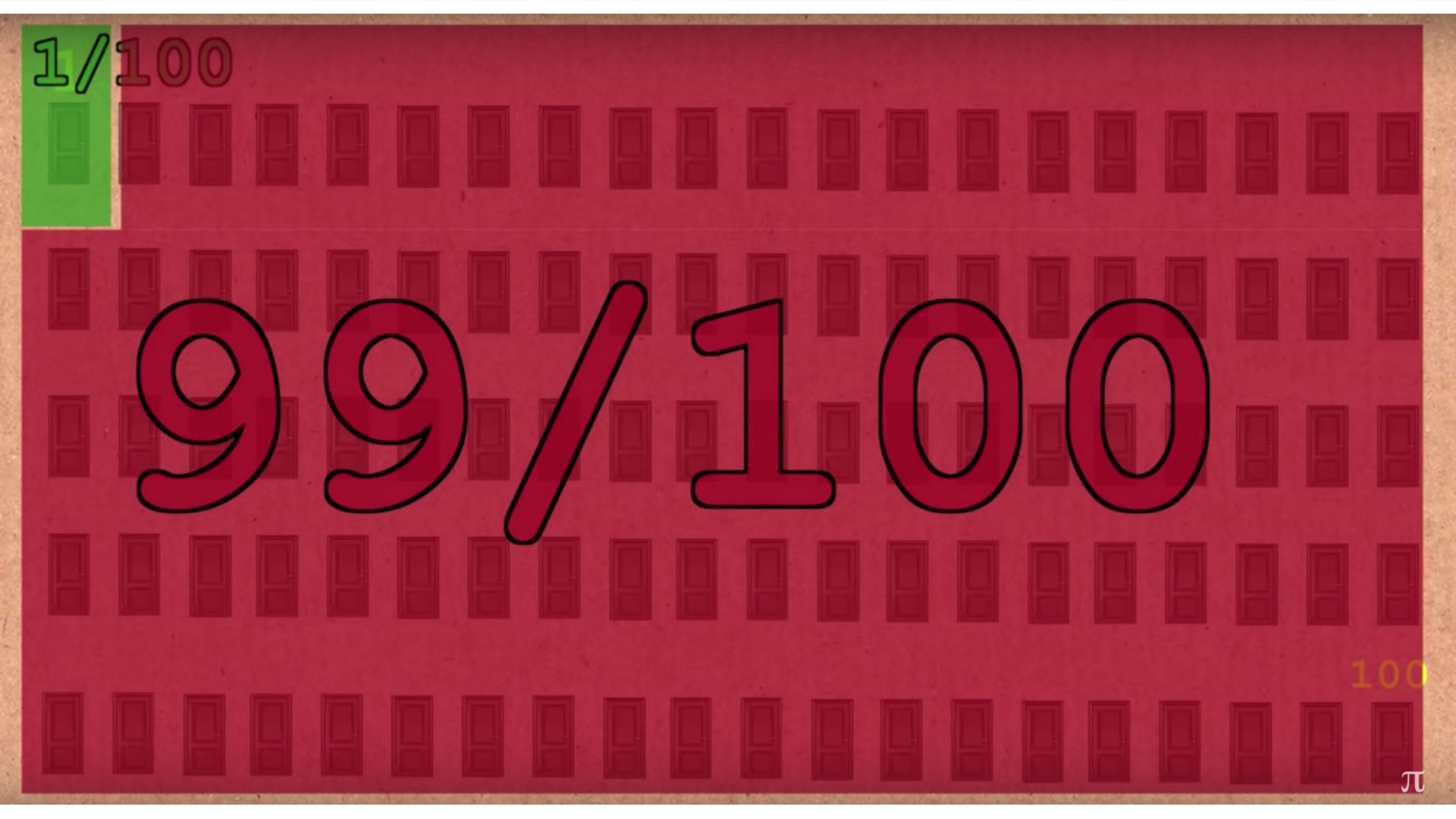
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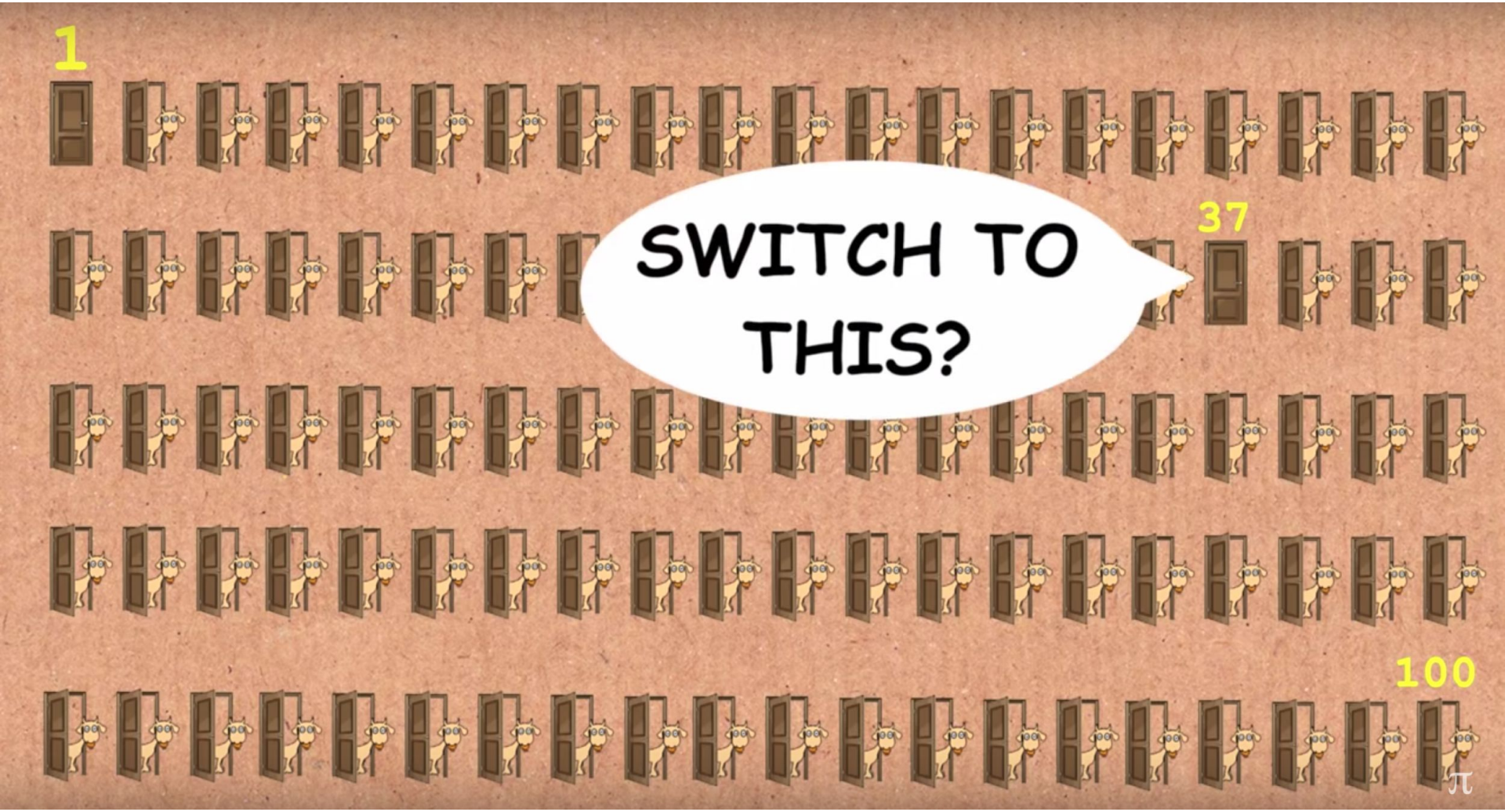
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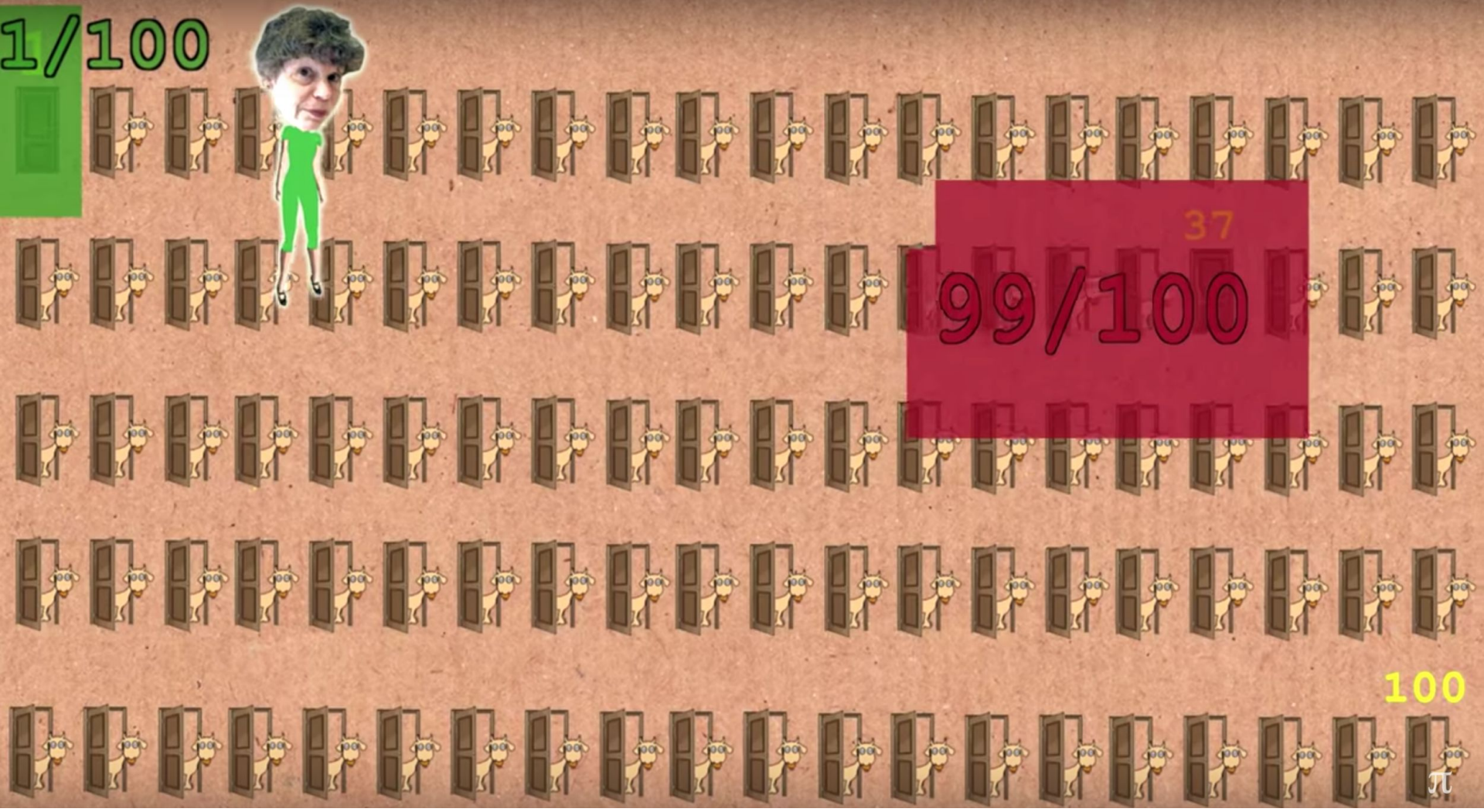
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Want to see this in action? 😱😱😱

- http://www.ginnytice.com/MontyHall/
- Change the number of doors!

But the ‘controversy’ still persists….

- If you read the comments on some of the videos explaining this problem, there’s still people insisting it’s ½ - even on a video with a great explanation!

“Our brains are just not wired to do probability problems very well, so I'm not surprised there were mistakes,” Stanford stats professor Persi Diaconis told a reporter, years ago. “[But] the strict argument would be that the question cannot be answered without knowing the motivation of the host."

Now back to the original question….

When is a pigeon smarter than a math professor?

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Are Birds Smarter Than Mathematicians? Pigeons (*Columba livia*) Perform Optimally on a Version of the Monty Hall Dilemma

Walter T. Herbranson and Julia Schroeder

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Abstract

Go to:

The "Monty Hall Dilemma" (MHD) is a well known probability puzzle in which a player tries to guess which of three doors conceals a desirable prize. After an initial choice is made, one of the remaining doors is opened, revealing no prize. The player is then given the option of staying with their initial guess or switching to the other unopened door. Most people opt to stay with their initial guess, despite the fact that switching doubles the probability of winning. A series of experiments investigated whether pigeons (*Columba livia*), like most humans, would fail to maximize their expected winnings in a version of the MHD. Birds completed multiple trials of a standard MHD, with the three response keys in an operant chamber serving as the three doors and access to mixed grain as the prize. Across experiments, the probability of gaining reinforcement for switching and staying was manipulated, and birds adjusted their probability of switching and staying to approximate the optimal strategy. Replication of the procedure with human participants showed that humans failed to adopt optimal strategies, even with extensive training.

WHO WOULD WIN?

A MATH PH.D. WITH YEARS OF EXPERIENCE

ONE SQUAWKY BOI

In conclusion…. We have a winner:

References

- http://www.math.ucsd.edu/~crypto/Monty/montybg.html
- https://priceonomics.com/the-time-everyone-corrected-the-worlds-smartest/
- https://www.youtube.com/watch?v=4Lb-6rxZxx0
- https://www.math.ucdavis.edu/~swalcott/Monty_Hall_17Cs2018.pdf
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3086893/

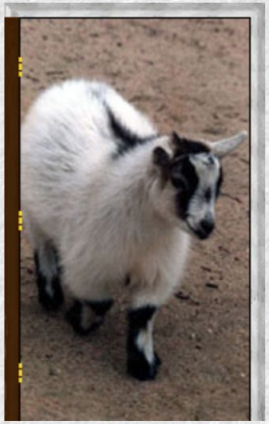
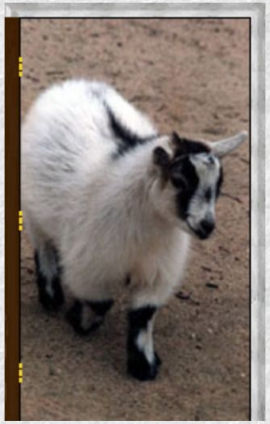
Rejected slides

Want to see this in action? 😱😱😱

- http://www.math.ucsd.edu/~crypto/Monty/monty.html

When in doubt, at least we have models and statistics to show us the way!

Monty Knows

CONGRATULATIONS! You're a winner!

RECAP: You originally picked door 2 and then switched to door 1.

Here is a summary of how previous contestants have fared.

	# of Players	Winners	Percent Winners
Switched	164	108	65.9
Didn't Switch	143	48	33.6

So what happened to the angry letter writers?

- At least one of them apologized:

Among the new believers was Robert Sachs, a math professor at George Mason University, who'd originally written a nasty letter to vos Savant, telling her that she "blew it," and offering to help "explain." After realizing that he was, in fact, incorrect, he felt compelled to send her another letter -- this time, repenting his self-righteousness.

"After removing my foot from my mouth I'm now eating humble pie," he wrote. "I vowed as penance to answer all the people who wrote to castigate me. It's been an intense professional embarrassment."

Of course, we made the following assumptions:

1. Monty will always open a door.
2. Monty never opens the door you have chosen.
3. Monty never opens the door with the car behind it.
4. The car is equally likely to be behind any door.
5. Given a choice of doors, Monty chooses at random.

Of course, on the real show it wasn't quite this simple...

Hall clarified that things worked a bit differently than the scenario presented by the *Parade* reader in vos Savant's column. In the real show, for instance, he retained the authority to offer the contestant cash NOT to switch. Details like this, he said, altered the contestant's mindset:

> *"[After I opened a door with a goat], they'd think the odds on their door had now gone up to 1 in 2, so they hated to give up the door no matter how much money I offered...The higher I got, the more [they] thought the car was behind [the other door]. I wanted to con [them] into switching there. That's the kind of thing I can do when I'm in control of the game. You may think you have probability going for you when you follow the answer in her column, but there's the psychological factor to consider."*