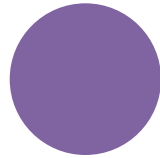
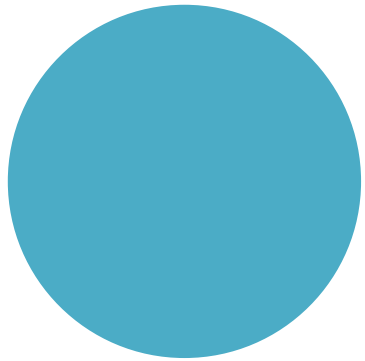


# **CAM EXTRAORDINARY CLAIMS**

How CAM are extremely improbable and is silly to trust them



# HUME ON MIRACLES

Philosophy old  
tricks can teach a  
lot to medicine

# David Hume

“A wise man...  
proportions his belief  
to the evidence.”



# Novel Testimony

Suppose that we get testimony concerning something we have never experienced.

Hume imagines someone from the equatorial regions being told about frost, and snow, and ice. They have never experienced anything like that before.



It's Strange!

Hume thinks this person would have reason to disbelieve stories about a white powder that fell from the sky, covered everything by several inches, and then turned to water and went away.

It's not that they should believe the stories are **not** true, just that they don't have to believe they **are** true. We need more evidence, because the prior is so low.

But now suppose someone tells us an even stranger story.

It's like the snow-story, in that we've never experienced anything like it before. But it's even stranger, because we have **always** experienced the **opposite** before.



# Miracles

For Hume, this is the definition of a miracle. A miracle is a violation of the laws of nature. Every event or process in the world conforms to the laws of nature (for example, the laws of physics like the law of gravity)– except, if there are any, miracles.

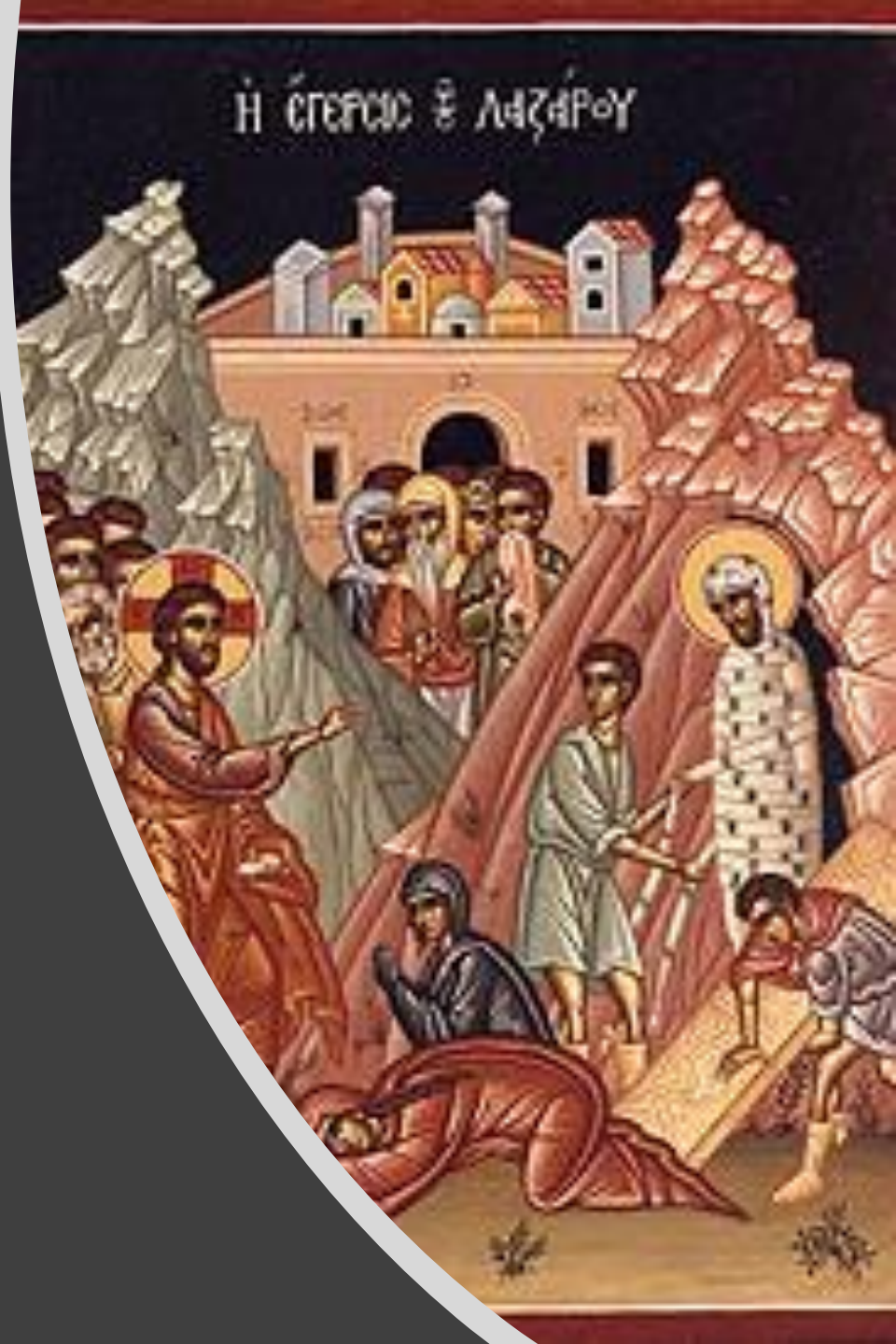
# Example

There are about 100 billion people who have lived and died in the history of humanity (and there are 7 billion more who are alive now).

As far as we know, none of the 100 billion people who have ever died and were dead for four days, later came back to life. It's a law of nature that when you die, that's the end, there's no more.

# Lazarus

Although there is testimony, in at least one religious book— the Christian bible— that such an event occurred at least once in history, when Jesus raised Lazarus from the dead, after he had been dead for four days.



# What Should We Believe?

According to Hume, we should be wise and apportion our belief to the evidence.

Since on the one hand we have 100 billion people who died and never came back, and on the other hand we have an old legend from a book intended to make people believe its religious views, it's most probable that the raising of Lazarus never happened.

# Hume on Miracles

“No testimony is sufficient to establish a miracle, unless the testimony be of such a kind that its falsehood would be more miraculous than the fact which it endeavors to establish.”



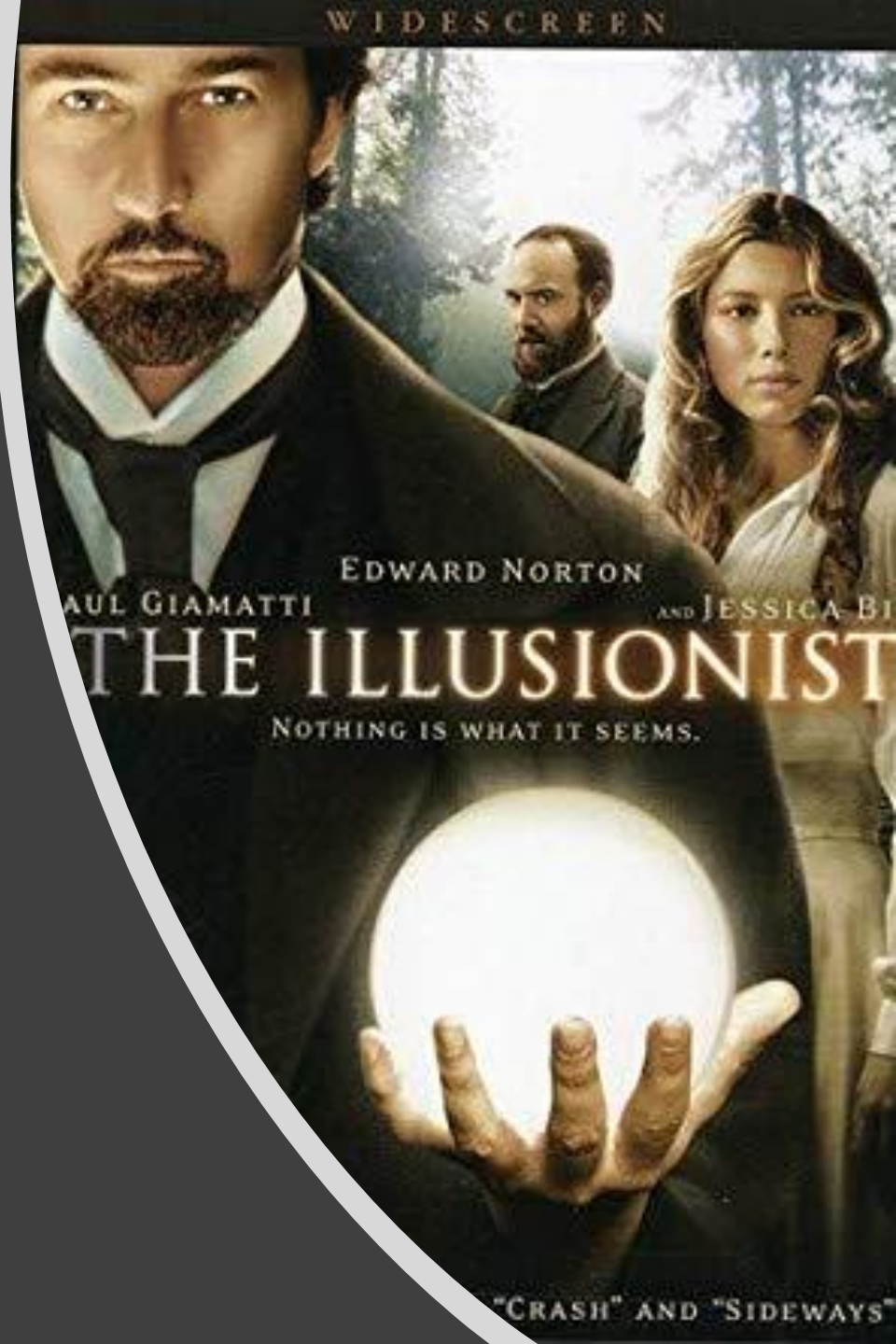
# Seeing and Believing

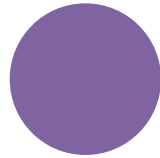
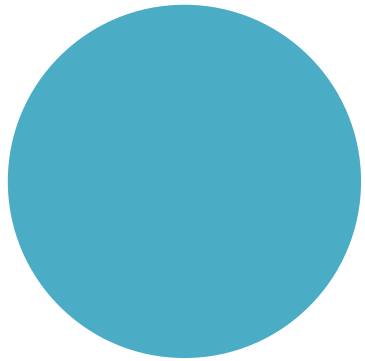
So, for example, Hume would even say that if you saw someone die and come back to life, you should not believe that it really happened.

# Seeing and Believing

Because it's always possible that what you saw was a trick, or the person was never really dead, or you were on drugs or...

Since none of those suppositions are miraculous, you should believe them instead of believing in the miracle. They're more likely than a violation of nature's laws.





# **NO MORE PHILOSOPHY!**

The Power of  
Bayes vs the  
power of biases



# OK, Back to Science...

There's a debate among scientists about Evidence Based Medicine vs. Science Based Medicine.

They sound the same, but they're very different!

# Modern Medicine

In current modern medicine the following is (one) best estimate:

- 37% of treatments are based on Randomized Controlled Trials
- 76% of treatments are based on good evidence (RCTs, observational studies)
- The rest should be based on scientific theory (reasonable extension of what we know).

# Evidence Based Medicine

One idea is that the 76% of tested-treatments are the “real” evidence based medicine and the rest is no better than untested alternative medicine. These are equal:

- Treatments based on scientific theory (reasonable extension of what we know).
- Untested pre-scientific or otherwise alternative treatments (e.g. homeopathy).

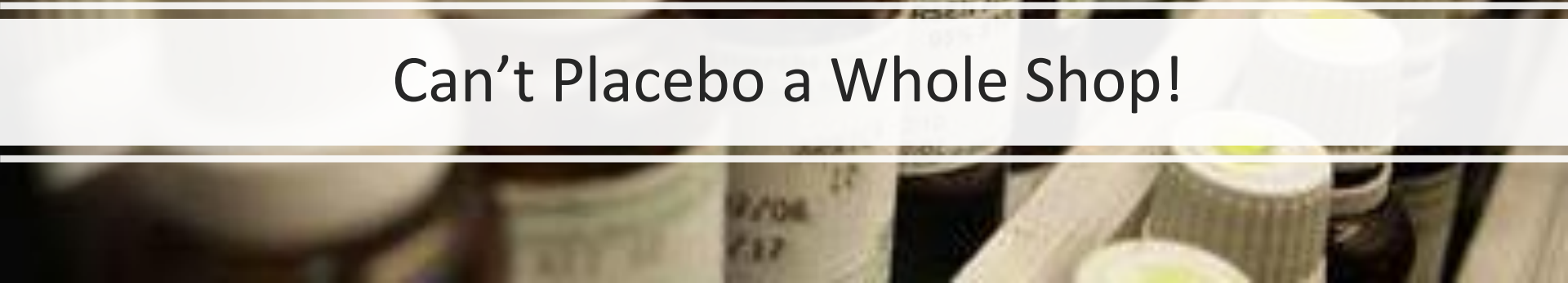
# Difficult Tests

Some alternative treatments are difficult to test.

Homeopaths claim that their treatments are individualized. So it's not enough to give everyone suffering from a disease the same magic water... they have to come into the shop for a personalized experience.



Can't Placebo a Whole Shop!



# False Equivalence

This means we should let the homeopaths “get away with it.” Sure, their treatments aren’t supported by science, but neither are 24% of modern treatments.

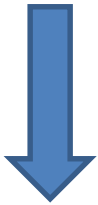
# THOMAS BAYES

We should take into  
account *prior*  
*probability*.



# Bayes' Theorem

Posterior



$P(\text{hypothesis/ data}) =$

Prior



$P(\text{data/ hyp.}) \times P(\text{hyp.})$

$\div$

$P(\text{data})$



# Science Based Medicine

We have lots of scientific knowledge of water. Nothing about it says that chemically pure water that in the past contained other chemicals and was then shaken should behave any differently than regular chemically pure water

# Science Based Medicine

And, science based medicine says that the 24% of treatments that are not evidence based, while they should still be tested, are much better because of prior probability.

If science tells us why they should work, then we should believe the science even if we haven't tested them (yet) or can't test them.

# Untested medical treatments vs silly treatments: an example

It's immoral not to perform blood transfusions on people who have lost lots of blood.

So we can't do a RCT on blood transfusions.

But we have a lot of knowledges on human physiology which enhances the prior probability of blood transfusions to be safe and effective

**This is why they're not as silly as homeopathy.**

# What prior probability should be assigned to homeopathy?

- For homeopathy to be true one should plan experiments of accuracy and statistical potency comparable to the best modern physics experiments – such as the Higgs Boson finding – because one must contradict them
- You should repeat enough testing on such a large population, to contradict also the full body of experiments in Chemistry

# Lesson learned

The prior probabilities of homeopathy to be true - as for any other medicine **ALTERNATIVE** to science – are so low that it is simply insane to believe in it

Homeopathy and non official medicine proponents are then struggling to call them **COMPLEMENTARY** practices for avoiding at least to confront the problem of overturning scientific evidence (so to increase the prior probabilities in favour of homeopathy)

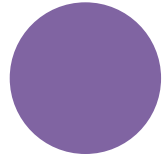
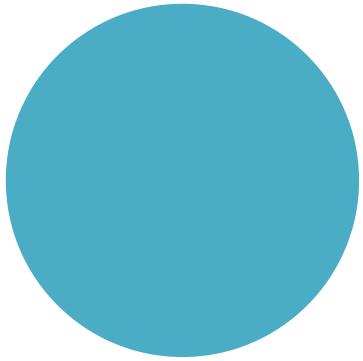
# But even if you claim that homeopathy is complementary, not alternative to scientific medicine:

- For homeopathy to be true, you should contradict the accumulated evidence coming from clinical evidence based on several hundred thousands of patients in formal tests
- The fact that patients happily assume homeopathic treatments **IS NOT** evidence of its effectiveness (***accounts are not evidence***)
- The same holds true for the accounts of thousands of doctors (***accounts are not evidence***)

CARL SAGAN

“Extraordinary  
claims require  
extraordinary  
evidence.”





**THANK YOU!**

