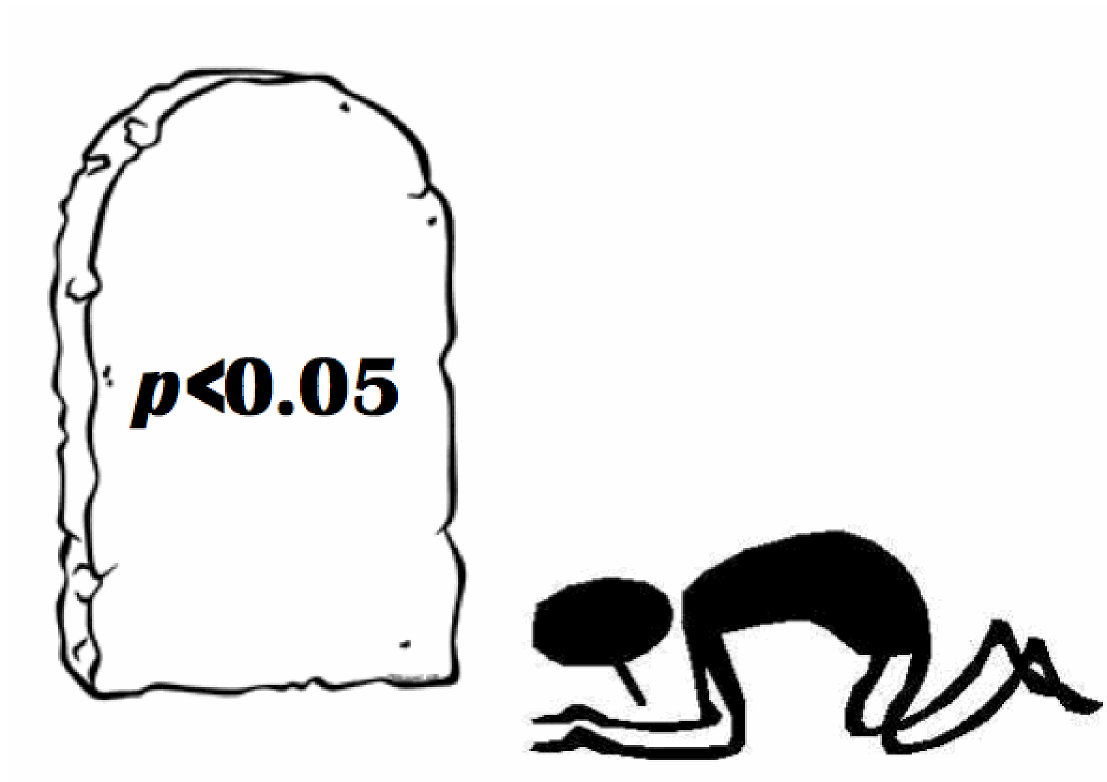
What is a *p*-value?



Why is the *p*-value so successful in science?

In some sense it offers a first line of defense against being fooled by randomness, separating signal from noise.

Benjamini, 2016

p-values tell you how **surprising** the **data** is, assuming there is **no effect**.

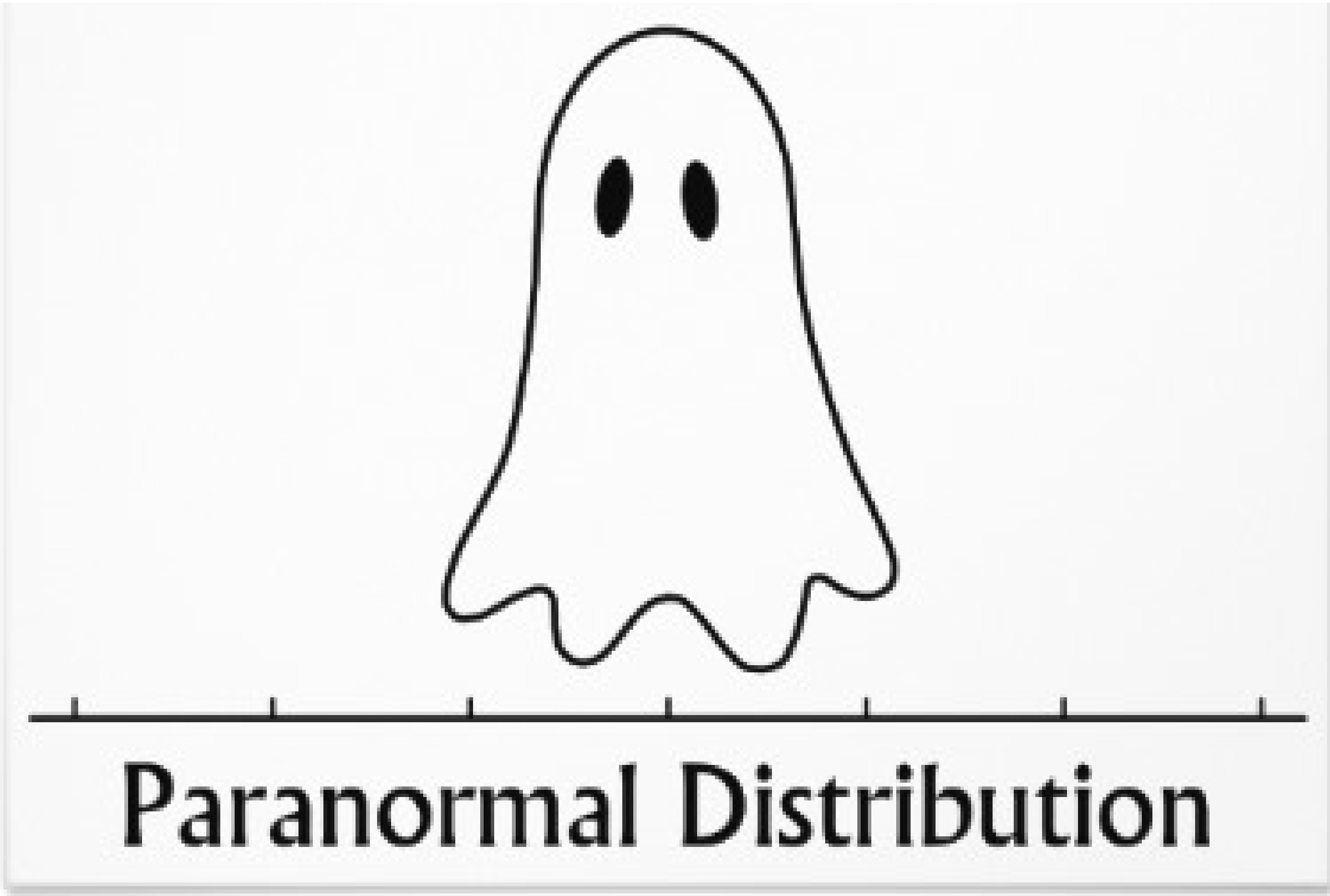
p-values are what you use if you don’t know Bayesian statistics

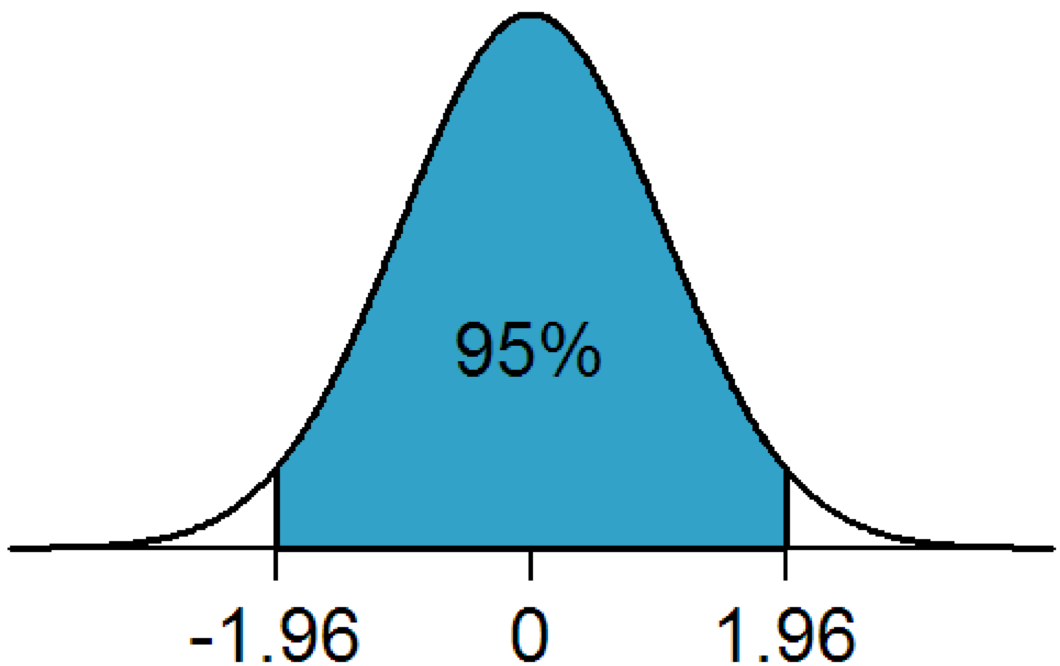
Does driving while calling increase the risk of a car accident?

The difference is never exactly zero. A difference of e.g., 0.11 means:

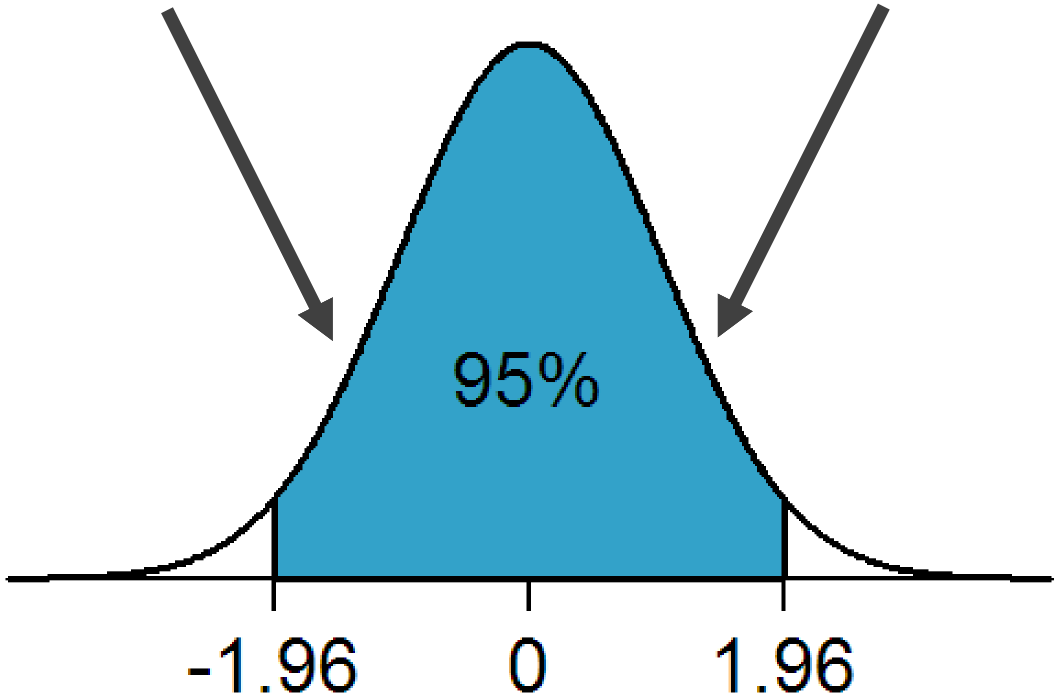
A) Probably just random noise
B) Probably a real difference

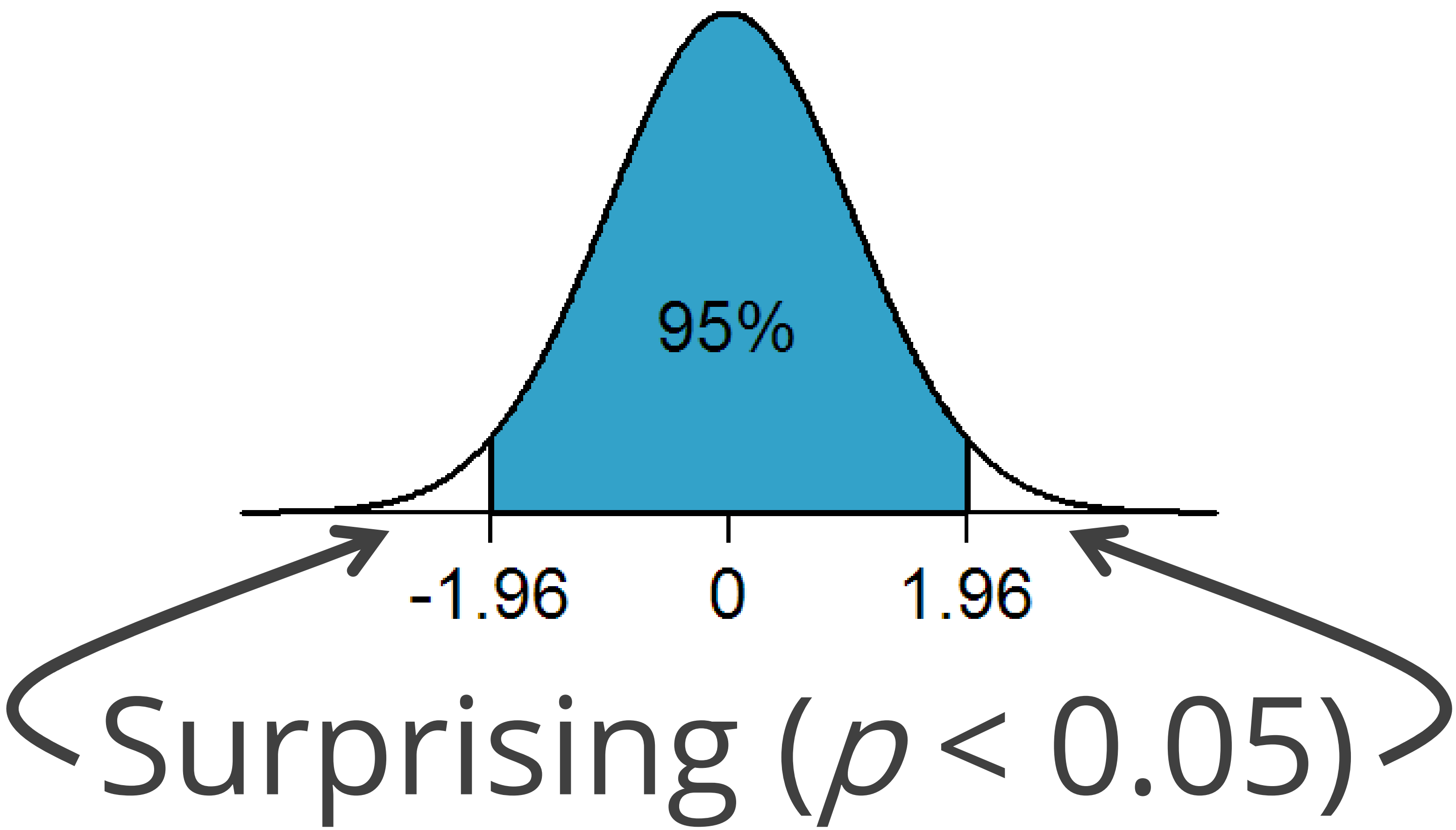
From the *M*, *SD*, and *N*, we calculate a test-statistic, and compare it against a distribution.


Paranormal Distribution


95%
-1.96
0
1.96

Not surprising ($p > 0.05$)




95%
-1.96
0
1.96
Surprising (p < 0.05)

A *p*-value is the probability of getting the observed or more extreme **data**, assuming the null hypothesis is true

A *p*-value is the probability of the **data**, *not* the probability of a **theory**.

SCIENCE

THE RACE TO PROVE 'SPOOKY' QUANTUM CONNECTION MAY HAVE A WINNER

In other words, there is a 96% probability they won the race, says PK, a quantum physicist

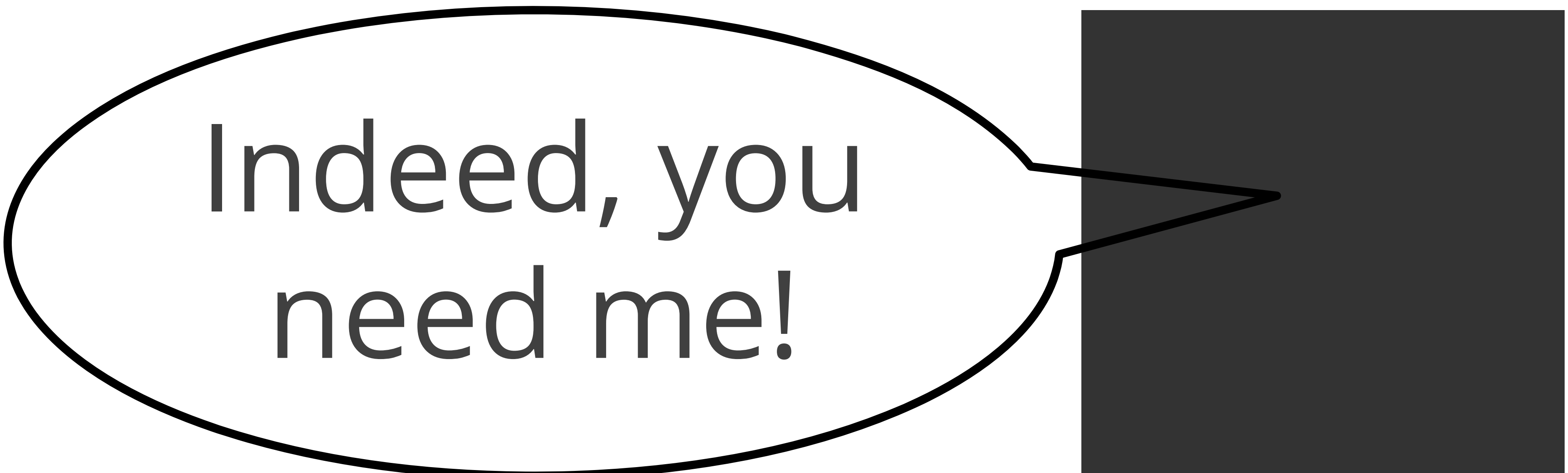
From http://www.popsci.com/race-prove-spooky-quantum-connection-may-have-winner

After $p < 0.05$, an effect is not 95% likely to be true (e.g., pre-cognition)

You can't get the probability the null hypothesis is true, given the data, from a *p*-value.

$$\mathbf{P(D^* | H) \neq P(H | D)}$$

(we need Bayesian statistics for this)



If a *p*-value is **larger** than 0.05, the data we have observed is **not surprising**.

$p > 0.05$ does not mean there is *no* true effect. **You need large samples to detect small effects.**

I try to think of

$p > 0.05$ as

無

A monk asked a Chinese Zen master: ‘Has a dog Buddha-nature or not?’ The Zen master answered:

無

Using *p*-values correctly

Use *p*-values as a **rule** to **guide behavior** in the **long run**.

Using *p*-values correctly

$p <$ alpha: Act as if data is not noise.

$p >$ alpha: Remain uncertain or act as if data is noise.

When you **act as if** there is an effect when $p < 0.05$, **in the long run** you won't be wrong more than 5% of the time.