Effective Communication of Risk & Uncertainty With Non-Experts

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1

UMassAmherst | Data Analytics and Computational Social Science Program

Agenda

I. Introduction and Motivating Warm-Up Questions

II. Characterizing Probabilities: Strategies for Effective Communication

III. Risk Communication: Common Pitfalls & Solutions

IV. Probabilistic ("Optical") Illusions

V. Wrap-Up and Recommendations
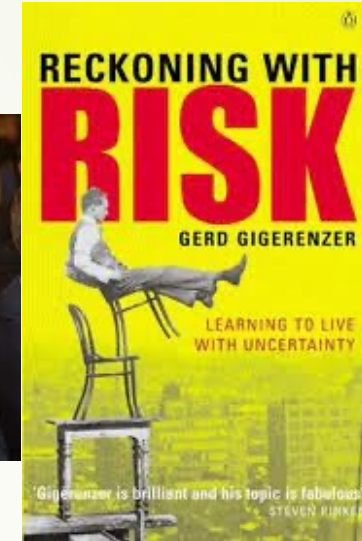
Workshop Heavily Influenced By…
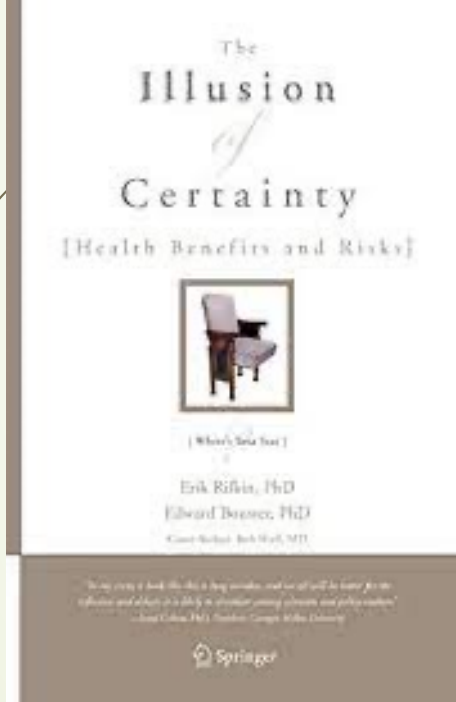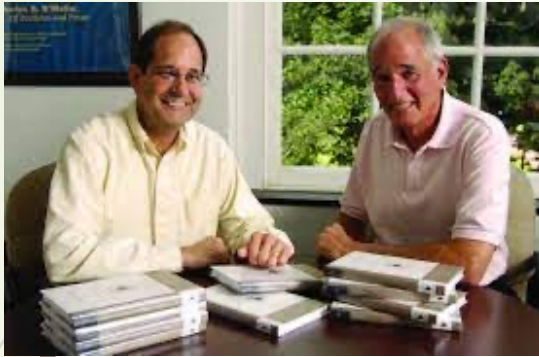
Rifkin, E., & Bouwer, E. (2007). *The Illusion of certainty: Health benefits and risks*. Springer.
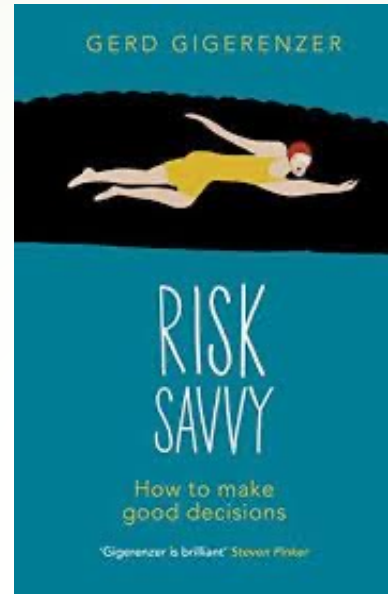
Gigerenzer, G. (2015). *Risk savvy: How to make good decisions*. Penguin.

Gigerenzer, G. (2003). *Reckoning with risk: learning to live with uncertainty*. Penguin.

Highly Recommended Books

Poll #1

➡ Suppose: One in a thousand people has a particular form of congenital heart condition. There is a test to detect it.

➡ The test is 99% accurate for those with the defect and 95% accurate for those without it.

➡ A randomly selected person is screened for the condition at an annual physical and tests *positive*.

Poll #1

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➥ The test is 99% accurate for those with the defect and 95% accurate for those without it.

➥ A randomly selected person is screened for the condition at an annual physical and tests *positive*.

WELL, APPARENTLY, IN THE MEDICINE COMMUNITY, 'NEGATIVE' MEANS 'GOOD' - WHICH MAKES ABSOLUTELY NO SENSE

IN THE REAL WORLD COMMUNITY THAT WOULD... BE CHAOS.

Positive test is *bad* news.

But how concerned should they be?

Poll #1

➡ Suppose: One in a thousand people has a particular form of congenital heart condition. There is a test to detect it.

➡ The test is 99% accurate for those with the defect and 95% accurate for those without it.

➡ A randomly selected person is screened for the condition at an annual physical and tests *positive*.

➡ Probability that this person in fact has the condition?

Use your intuition: What seems about right?

Poll #2

WebMD

Pancreatic Cancer Linked to Sodas?

Study Says 2 Sodas Per Week Raises Pancreatic Cancer Risk; Beverage Industry Says Study Is Flawed

Written by Kathleen Doheny

✔ Medically Reviewed by Louise Chang, MD on February 08, 2010

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EATING AND HEALTH

Even If You're Lean, 1 Soda Per Day Ups Your Risk Of Type 2 Diabetes

July 23, 2015 · 4:26 PM ET
Heard on All Things Considered

ALLISON AUBREY

X doubles the risk of Y!

- "Drinking as little as two soft drinks a week appears to nearly **double** the risk of getting pancreatic cancer, according to a new study."

- "Even If You're Lean, 1 Soda Per Day Ups Your Risk Of Type 2 Diabetes"
  - A new study published in the British Medical Journal finds that people in the habit of drinking one sugar-sweetened beverage — such as a soda or sweetened tea — every day had an **18 percent increased risk** of developing the disease over a decade.

- **Which is more worrisome?**

http://www.webmd.com/cancer/pancreatic-cancer/news/20100208/pancreatic-cancer-linked-sodas

http://www.npr.org/sections/thesalt/2015/07/23/425635400/even-if-youre-lean-1-soda-per-day-ups-your-risk-of-diabetes

Presidential Polling

- Which polling average from the week before Election Day came *closest* to the final national popular vote?
  - Obama vs. Romney 2012

  - Trump vs. Clinton 2016

  - Biden vs. Trump 2020

Poll #3

Presidential Polling

- Which polling average from the week before Election Day came *closest* to the final national popular vote?
  - Obama vs. Romney 2012
  - Trump vs. Clinton 2016
  - Biden vs. Trump 2020
- Which polling average was *furthest* from final vote?

RealClear Politics

2012 — Polling Data

Poll	Date	Sample	MoE	Obama (D)	Romney (R)	Spread
Final Results	--	--	--	51.1	47.2	Obama +3.9
RCP Average	10/31 - 11/5	--	--	48.8	48.1	Obama +0.7

2016 — Polling Data

Poll	Date	Sample	MoE	Clinton (D)	Trump (R)	Spread
Final Results	--	--	--	48.2	46.1	Clinton +2.1
RCP Average	11/1 - 11/7	--	--	46.8	43.6	Clinton +3.2

2020 — Polling Data

Poll	Date	Sample	MoE	Biden (D)	Trump (R)	Spread
Final Results	--	--	--	51.4	46.9	Biden +4.5
RCP Average	10/25 - 11/2	--	--	51.2	44.0	Biden +7.2

RealClear Politics

Error

2012 Polling Data

Poll	Date	Sample	MoE	Obama (D)	Romney (R)	Spread
Final Results	--	--	--	51.1	47.2	Obama +3.9
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3.2 %

2016 Polling Data

Poll	Date	Sample	MoE	Clinton (D)	Trump (R)	Spread
Final Results	--	--	--	48.2	46.1	Clinton +2.1
RCP Average	11/1 - 11/7	--	--	46.8	43.6	Clinton +3.2

1.1 %

2020 Polling Data

Poll	Date	Sample	MoE	Biden (D)	Trump (R)	Spread
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RCP Average	10/25 - 11/2	--	--	51.2	44.0	Biden +7.2

2.7 %

High vs. Low Probabilities

- Is this a *high* probability or a *low* probability?
  - 0.1667
  - 16.67%
  - 1/6
  - 1 per 6
  - 5:1 odds against

Characterizing Probabilities with Natural Frequencies, Familiar Contexts

- People have difficulty reasoning based on percentages and decimals.
- Experts and the highly numerate have less difficulty, but
  - This is because they can mentally convert to frequencies
  - Still tend not to distinguish well among very high (or low) probabilities
    - 0.017% vs. 0.000014%

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    - 0.017% vs. 0.000014%
    - 1 per 6000 vs. 1 per 7 million
    - 1 in entering UMass undergrad class vs. 1 in pop. of Mass

Historic failure?

mike murphy ✔
@murphymike

⚙ 👤+ Follow

I've believed in data for 30 years in politics and data died tonight. I could not have been more wrong about this election.

RETWEETS — 2,007
LIKES — 3,108
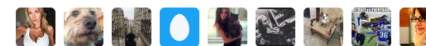
11:49 PM - 8 Nov 2016

How did pollsters get Trump, Clinton election so wrong?

Nathan Bomey , **USA TODAY**   8:54 a.m. EST November 9, 2016

"Pollsters flubbed the 2016 presidential election in seismic fashion."

"Donald Trump's victory dealt a devastating blow to the credibility of the nation's leading pollsters, calling into question their mathematical models, assumptions and survey methods."
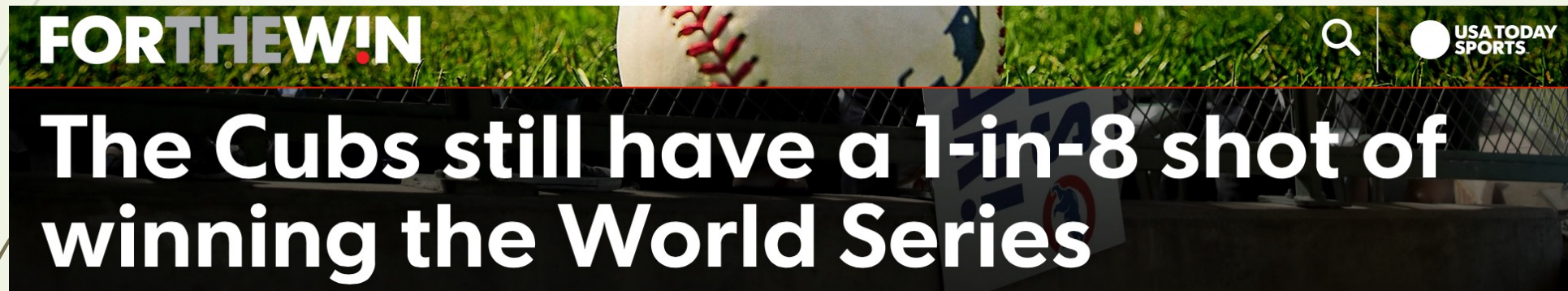
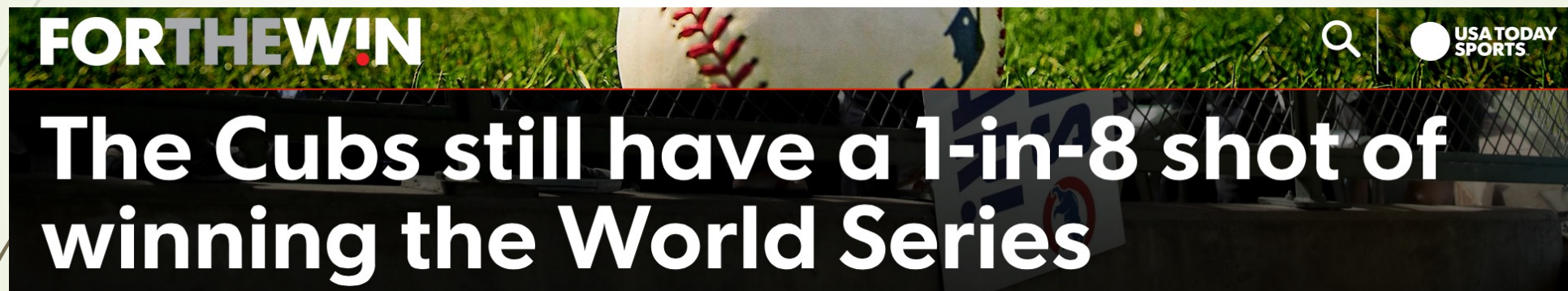**npr** NPR Weekend Edition
Scott Simon w/ Sean Trende (RCP)

Historic failure?

▪ Sports reporters give the Cubs, down 3-1 in the World Series, a 12.5% chance.

Historic failure?

- Sports reporters give the Cubs, down 3-1 in the World Series, a 12.5% chance.

FOR THE WIN

🔍 | ⚫ USA TODAY SPORTS

The Cubs still have a 1-in-8 shot of winning the World Series

FiveThirtyEight

Politics   Sports   Science & Health   Economics   Culture

OCT 30, 2016 AT 7:53 AM

The Cubs Have A Smaller Chance Of Winning Than Trump Does

Historic failure?

➥ Sports reporters give the Cubs, down 3-1 in the World Series, a 12.5% chance.

CUBS WIN! CUBS WIN!

The Chicago Cubs celebrate after Game 7 of the World Series against the Cleveland Indians in Cleveland. The Cubs won 8-7 in 10 innings to win the series 4-3.

ASSOCIATED PRESS

WORLD SERIES CHAMPIONS

Chicago Tribune

THURSDAY, NOVEMBER 3, 2016   CHICAGOTRIBUNE.COM

Anthony Rizzo hugs Kris Bryant, while Mike Montgomery, Javier Baez and Addison Russell celebrate after winning the World Series in Cleveland on Wednesday night.   BRIAN CASSELLA/CHICAGO TRIBUNE

At last!

Cubs capture first title in 108 years in extra-inning Game 7 thriller

Historic failure?

➡ I have a fair coin.

➡ That means that if I flip it three times, I have a 12.5% (1 in 8) chance of getting all three heads.

Historic failure?

- I have a fair coin.
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- Suppose I flip the coin three times and I get all heads. What's your reaction?

Historic failure?

- I have a fair coin.
- That means that if I flip it three times, I have a 12.5% (1 in 8) chance of getting all three heads.

- Suppose I flip the coin three times and I get all heads. What's your reaction?
  - I lied when I said the coin was fair?
  - I am incorrect in my calculation?

Historic failure?

➡ I have a fair coin.

➡ That means that if I flip it three times, I have a 12.5% (1 in 8) chance of getting all three heads.

➡ Low probability or high probability event?

Historic failure?

➠ I have a fair coin.

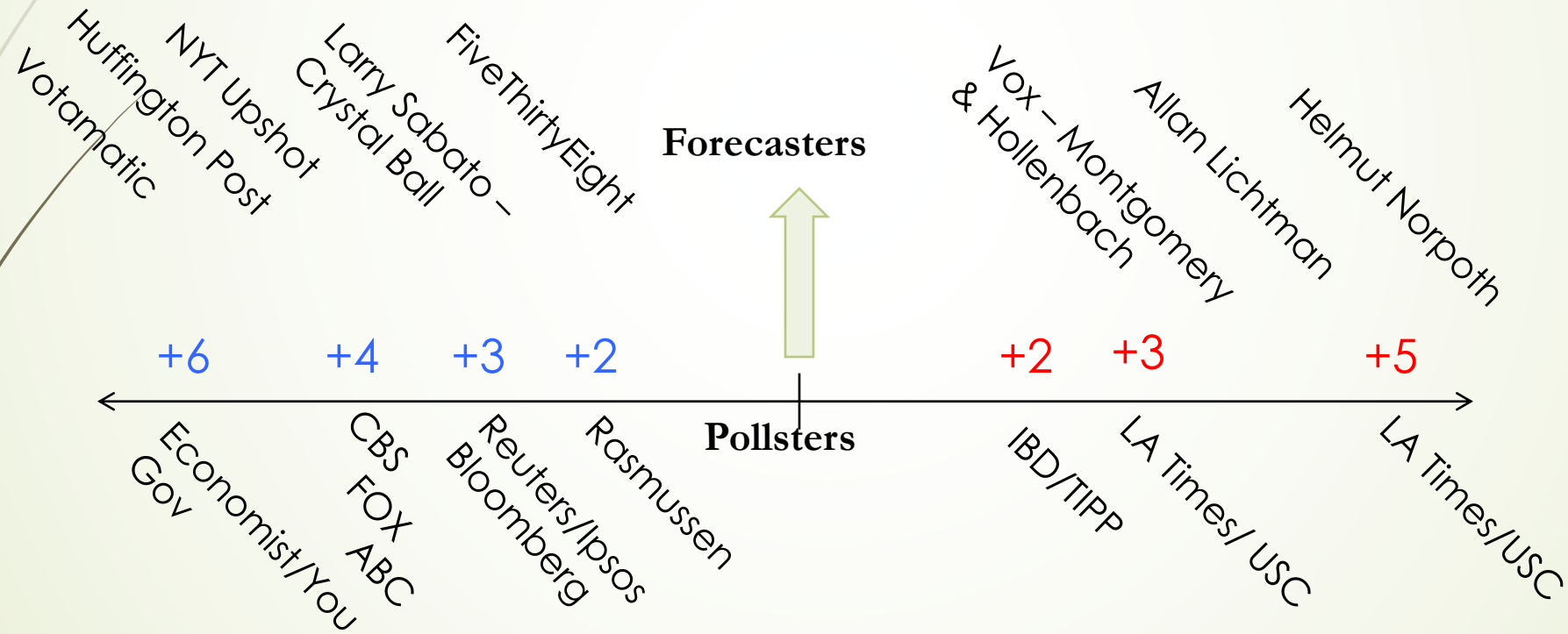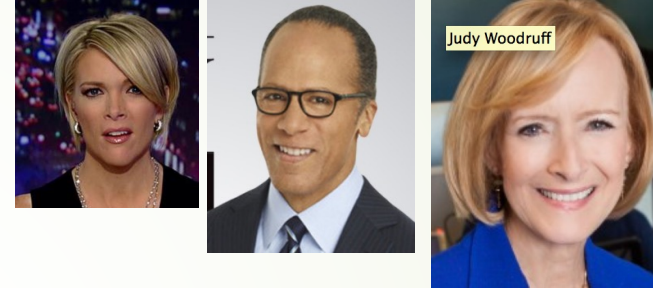➠ That means that if I flip it three times, I have a 12.5% (1 in 8) chance of getting all three heads.

➠ Low probability or high probability event?

➠ Your perception depends on what is at stake.

➠ Risk depends on both probability and potential loss/gain

Historic Failure in Communication

Talking Heads

Votamatic

Huffington Post

NYT Upshot

Larry Sabato –
Crystal Ball

FiveThirtyEight

Forecasters

Vox – Montgomery
& Hollenbach

Allan Lichtman

Helmut Norpoth

+6   +4   +3   +2   +2   +3   +5

Pollsters

Economist/You
Gov

CBS
FOX
ABC

Reuters/Ipsos
Bloomberg

Rasmussen

IBD/TIPP

LA Times/ USC

LA Times/USC

Informational Food Chain

Talking Heads

98% 96% 85% 71% 51% T 95%

Huffington Post Votamatic NYT Upshot Larry Sabato – Crystal Ball FiveThirtyEight Vox – Montgomery & Hollenbach Allan Lichtman Helmut Norpoth

Forecasters

+6 +4 +3 +2 +2 +3 +5

Pollsters

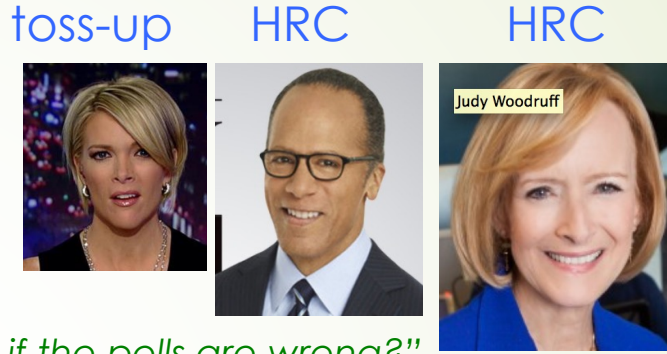Economist/You Gov CBS FOX ABC Reuters/Ipsos Bloomberg Rasmussen IBD/TIPP LA Times/ USC LA Times/USC
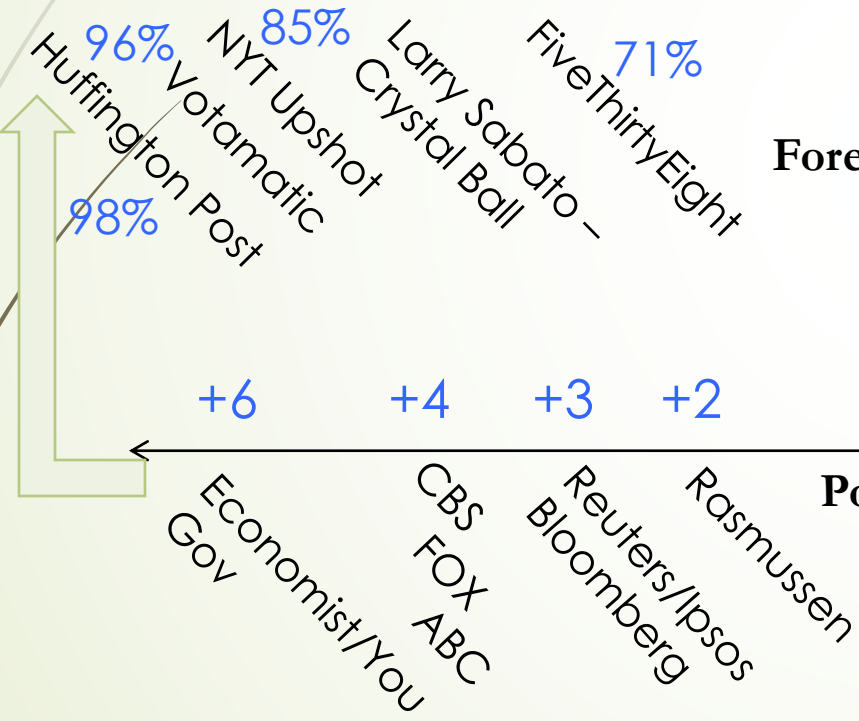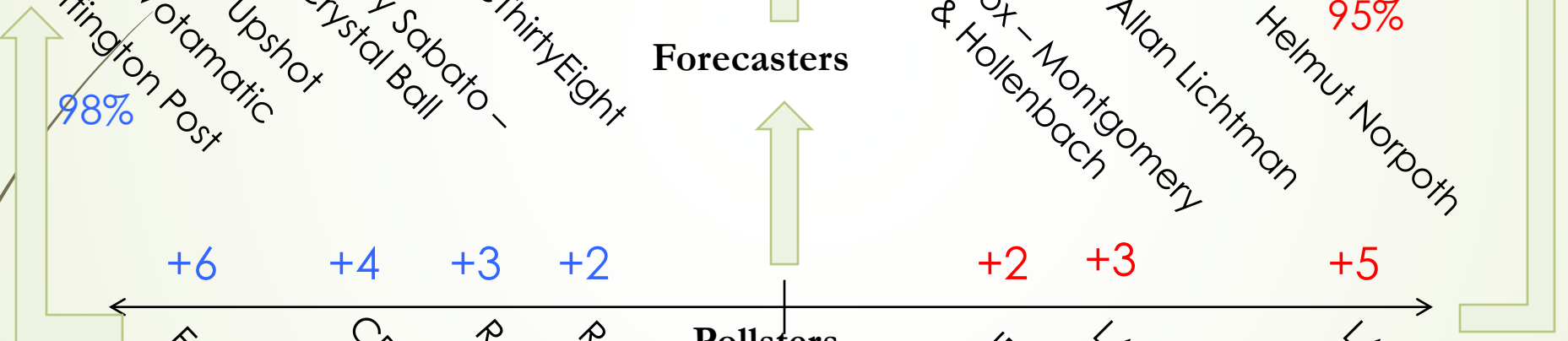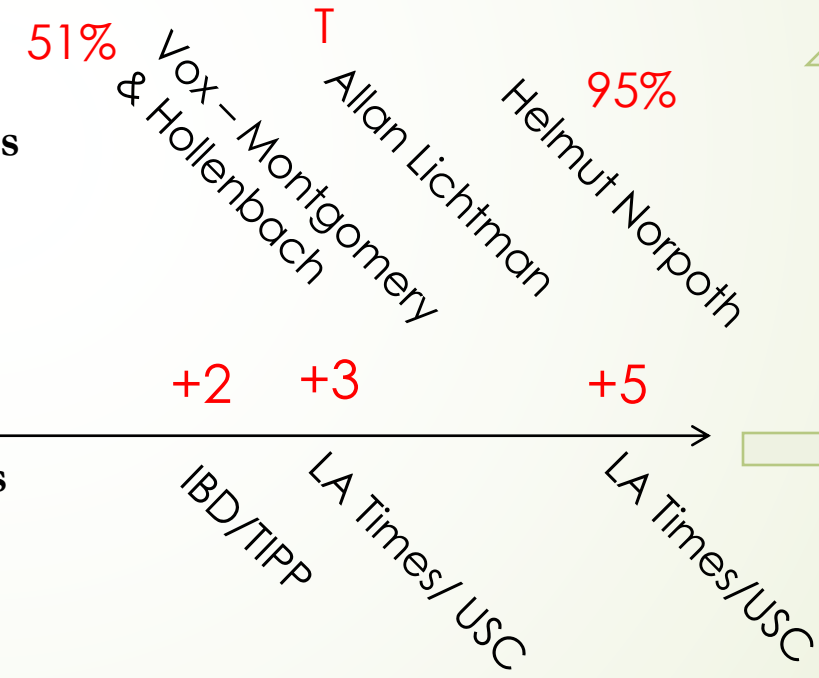
The Washington Post
Democracy Dies in Darkness

MONKEY CAGE

How to better communicate election forecasts — in one simple chart

Analysis by Justin H. Gross

November 29, 2016 at 5:00 a.m. EST

https://www.washingtonpost.com/news/monkey-cage/wp/2016/11/29/how-to-better-communicate-election-forecasts-in-one-simple-chart/

Risk Characterization Theatre

Rifkin, E., & Bouwer, E. (2007). *The Illusion of certainty: Health benefits and risks*. Springer.

"What is the point of the prediction if the prediction doesn't happen?"-T. Noah
"It's not a prediction; it's a forecast. It's an estimate of risk."-N. Silver

FiveThirtyEight: Trump's Chances — 286 cases in 1,000

NYT Upshot: Trump's Chances — 150 cases in 1,000

HuffPo Pollster: Trump's Chances — 20 cases in 1,000
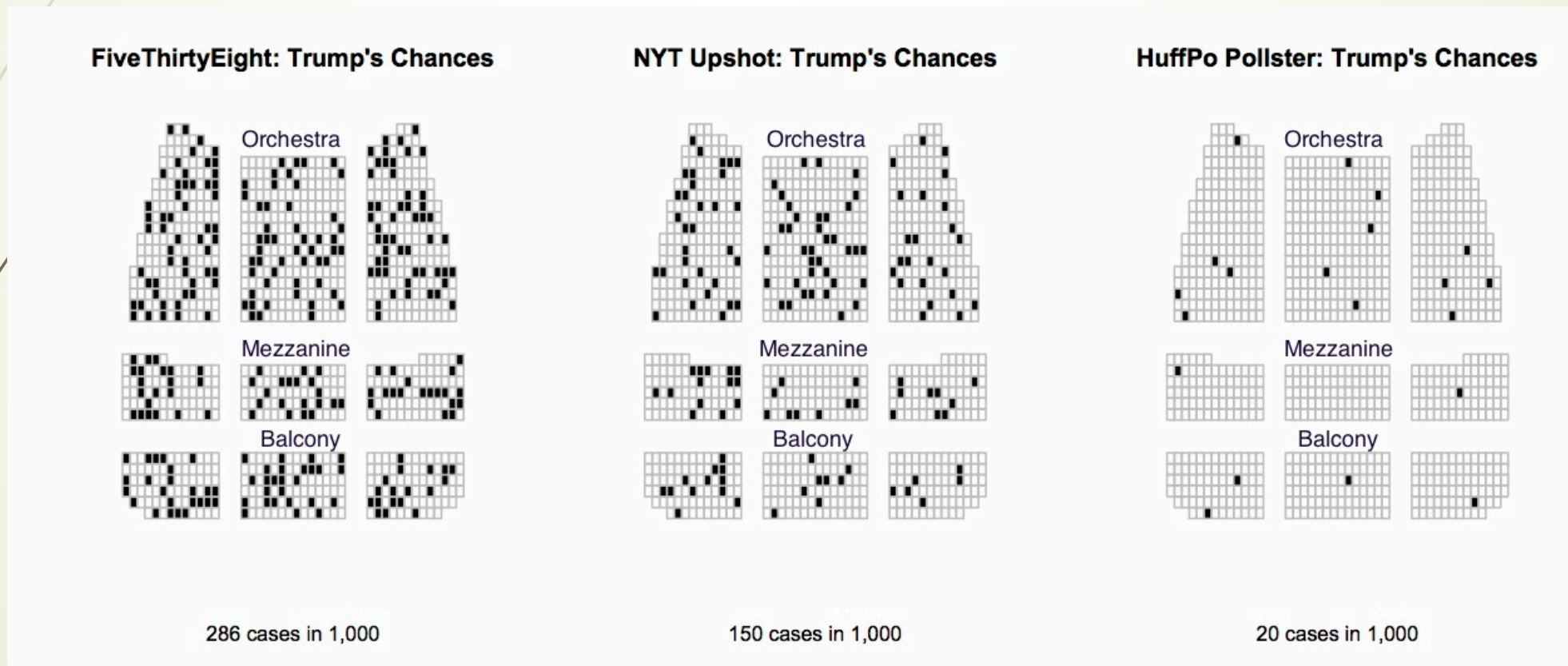
Pundits see: 0%   0%   0%

Risk Characterization Sports Arena

FiveThirtyEight: Trump's Chances

2,860 cases in 10,000

How likely are you to pick one of these cards?

Risk Characterization Casino

From a shuffled 52-card deck?
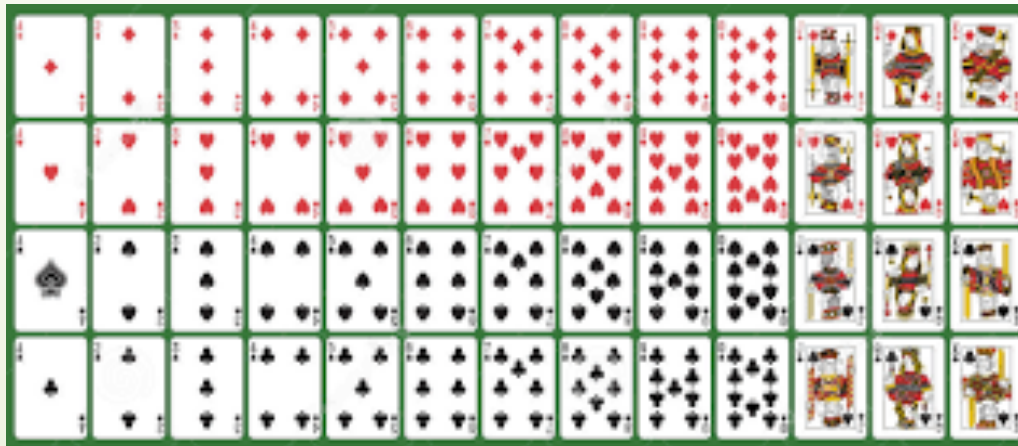
Risk Communication: Common Pitfalls and Solutions

- Illusion of Certainty

- Risk vs. Uncertainty

- Absolute vs. Relative Risk

- Individual vs. Population-based Decision-Making

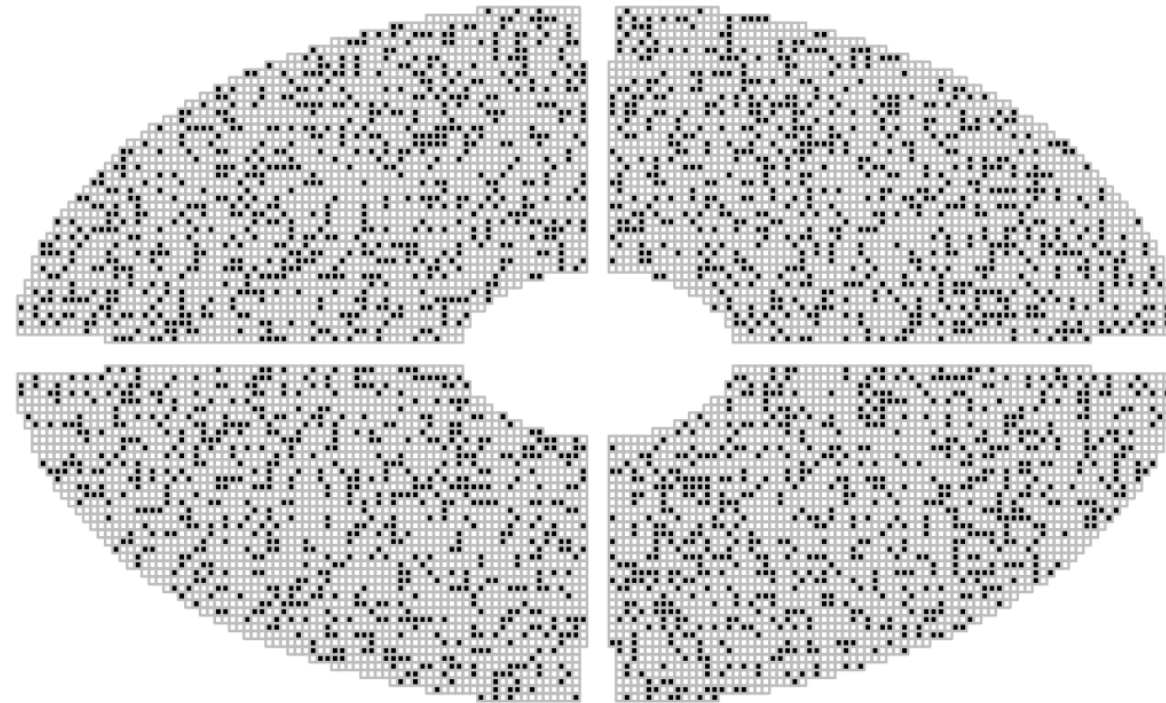# Illusion of Certainty

Is Red Wine Actually Good for You? Here's What the Research Suggests

There's a scientific link between drinking red wine and having better health, but there's no concrete evidence that booze is responsible.

By Jessica Migala   Medically Reviewed by Justin Laube, MD
Reviewed: September 15, 2020

Health Topics > Diet Nutrition > Alcohol Health > Wait, So Now Wine Is Bad For You?

Wait, So Now Wine Is Bad for You?

Seems like the story changes every day. Our expert weighs in on the potential health benefits of wine versus the risks.

NUTRITION   ✓ Evidence Based

Red Wine: Good or Bad?

Illusion of Certainty

➥ As scientific experts, do we encourage or dissuade members of the public, patients, clients, etc. from viewing scientific findings as "proof"?

  ➥ Dangers of excessive scientific humility

  ➥ Dangers of insufficient scientific humility

Illusion of Certainty

- As scientific experts, do we encourage or dissuade members of the public, patients, clients, etc. from viewing scientific findings as "proof"?
  - Dangers of excessive scientific humility
  - Dangers of insufficient scientific humility
- Honesty about what we think we know and why
  - Sources of uncertainty
  - What assumptions are involved in risk assessments?
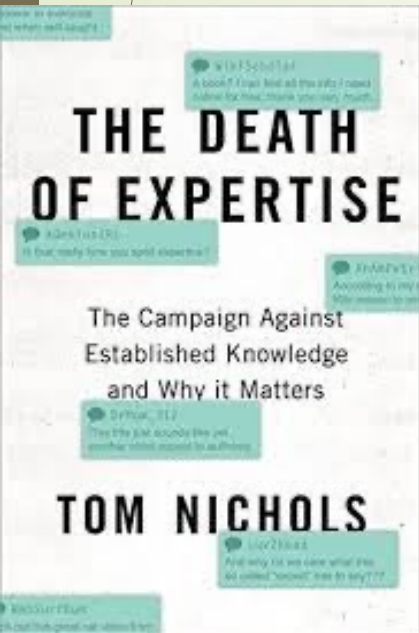 - How realistic are assumptions?

Illusion of Certainty

- As scientific experts, do we encourage or dissuade members of the public, patients, clients, etc. from viewing scientific findings as "proof"?
  - Dangers of excessive scientific humility
  - Dangers of insufficient scientific humility
- Honesty about what we think we know and why
- Mass rejection of expertise
  - Consequences of expecting certainty from experts (economists, doctors, politicians, lawyers, teachers, etc.)

THE DEATH OF EXPERTISE

The Campaign Against Established Knowledge and Why it Matters

TOM NICHOLS

%1

TWILIGHT OF THE ELITES
AMERICA AFTER MERITOCRACY

CHRISTOPHER HAYES
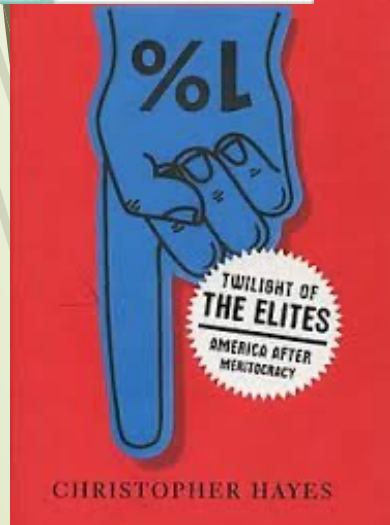
Illusion of Certainty: Leaders Know the Game

"Nothing comes to my desk that is perfectly solvable," Obama said at one point. "Otherwise, someone else would have solved it. **So you wind up dealing with probabilities. Any given decision you make you'll wind up with a 30 to 40 percent chance that it isn't going to work.** You have to own that and feel comfortable with the way you made the decision. You can't be paralyzed by the fact that it might not work out. On top of all of this, **after you have made your decision, you need to feign total certainty about it. People being led do not want to think probabilistically.**"

http://www.vanityfair.com/news/2012/10/michael-lewis-profile-barack-obama

Illusion of Certainty

"The quest for certainty is the biggest obstacle to becoming risk savvy." - Gerd Gigerenzer, *Risk Savvy*

Risk vs. Uncertainty

➡ The more evidence we obtain, the more confident we can be in our conclusions, right?

    ➡ Ask the turkey, who each morning becomes more confident that the farmer has arrived to feed—not harm—her.

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➧ Unknown risks add additional, 2nd order, uncertainty; we are uncertain about our quantification of risk.

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- What we call "risk" is actually *known risk*.
  - (Actually, usually *estimated* risk from data + assumptions)
- Unknown risks add additional, 2nd order, uncertainty; we are uncertain about our quantification of risk.
- Statisticians use *risk* to mean *expected **loss***.
  - Reminds us that *stakes* matter, as well as probabilities

Absolute vs. Relative Risk

➡ Which is more helpful to laypeople?

Absolute vs. Relative Risk

- Absolute Risk = one's risk of developing a disease (or other condition) over a specific period of time.

- Relative Risk or "Risk Ratio" (RR) = *ratio* of two absolute risk figures

- Relative Risk Reduction (RRR) = 100%(1-RR)

- Absolute Risk Reduction (ARR) = *difference* in absolute risks

- Scientific journals provide RR or odds ratios (OR)

Absolute vs. Relative Risk (Example)

44,551 nonhospitalized COVID-19 (Omicron) patients aged 50+

➡ Absolute Risk

➡ 0.55% of those treated with drug hospitalized or died

➡ 0.97% of those not treated were hospitalized or died

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    $$100\%(1\text{-}RR) = 100\text{x}(0.433)\% = 43.3\%$$

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" Paxlovid recipients were at a 40% lower risk for hospitalization and a 71% lower risk of death."

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How might one communicate this to a non-scientist?

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Around 4 more per 1000 avoid hospital/death

How might one communicate this to a non-scientist?

Absolute vs. Relative Risk

- Which is more helpful to laypeople?
  - Relative risk is primarily important to researchers.
  - Absolute risk is more important to the public & decision-makers.

- But journalists usually report relative risks. Why?

Absolute vs. Relative Risk

- Diabetes Drug Study
  - Experimental treatment and control groups
  - Twenty thousand men with diabetes in study
  - RRR is 50% "Cut your risk of death in half!"
  - Take the drug?

Absolute vs. Relative Risk

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  - Take the drug?
- Consider absolute risks:
  - 1 of 10,000 in treatment group died
  - 2 of 10,000 in control group died
  - Absolute risk reduction?

Absolute vs. Relative Risk

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  ➡ Experimental treatment and control groups

  ➡ Twenty thousand men with diabetes in study

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  ➡ Take the drug?

➡ Consider absolute risks:

  ➡ 1 of 10,000 in treatment group died

  ➡ 2 of 10,000 in control group died

  ➡ Absolute risk reduction? ARR = .0002 − .0001 = .0001 = .01%

Absolute vs. Relative Risk

➤ Diabetes Drug Study
  - ➤ Experimental treatment and control groups
  - ➤ Twenty thousand men with diabetes in study
  - ➤ RRR is 50% "Cut your risk of death in half!"
  - ➤ Take the drug?
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  - ➤ 1 of 10,000 in treatment group died
  - ➤ 2 of 10,000 in control group died
  - ➤ Absolute risk reduction? ARR = .0002 − .0001 = .0001 = .01%
➤ Number treated to save one life?

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    ➡ 2 of 10,000 in control group died

    ➡ Absolute risk reduction? ARR = .0002 − .0001 = .0001 = .01%

➡ Number treated to save one life? NNT = 10,000 patients

Family History of Colorectal Adenomatous Polyps and Increased Risk for Colorectal Cancer

Habibul Ahsan, MBBS, MMedSc; Alfred I. Neugut, MD, PhD; Gail C. Garbowski, MPH; Judith S. Jacobson, DrPH; Kenneth A. Forde, MD; Michael R. Treat, MD; and Jerome D. Waye, MD

[+] Article, Author, and Disclosure Information

Text Size: **A** A A

Patients: 1554 first-degree relatives of 244 patients with newly diagnosed adenomas and 2173 first-degree relatives of 362 endoscopically normal controls.

Measurements: Structured interviews were used to obtain family history. Adjusted relative risks (RR) were estimated from Cox proportional-hazards regression models.

Results: The risk for colorectal cancer was elevated (RR, 1.74 [95% CI, 1.24 to 2.45]) among first-degree relatives of patients with newly diagnosed adenomas compared with the risk among first-degree relatives of controls. This increased risk was the same for parents (RR, 1.58 [CI, 1.07 to 2.34]) and siblings (RR, 1.58 [CI, 0.81 to 3.08]). First-degree relatives of patients with adenomas did not have elevated risk for other cancers. The risk for colorectal cancer among family members increased with decreasing age at diagnosis of adenoma in probands. Among first-degree relatives of patients who were 50 years of age or younger when the adenoma was diagnosed, the risk was more than four times greater (RR, 4.36 [CI, 2.24 to 8.51]) than that among first-degree relatives of patients who were older than 60 years of age when the adenoma was diagnosed.

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Family history and colorectal cancer: predictors of risk.

Slattery ML[1], Levin TR, Ma K, Goldgar D, Holubkov R, Edwards S.

➤ Increased Risk Factors

- ➤ A family history of colorectal cancer in any first-degree relatives slightly increased risk of rectal cancer (**OR: 1.37** 95% CI: 1.02-1.85).

- ➤ Greatest risk among those diagnosed at age 50 or younger (**OR: 2.09** 95% CI: 0.94-4.65 for rectal tumors; **OR: 3.00** 95% CI: 0.98-9.20 for distal colon tumors; and **OR: 7.88** 95% CI: 2.62-23.7 for proximal colon tumors).

- ➤ Factors significantly associated with cancer risk among those with a family history of colorectal cancer, included a diet not Prudent, i.e. high in fruits, vegetables, whole grains, fish and poultry, (**OR: 2.79** 95% CI: 1.40-5.56); smoking cigarettes (**OR: 1.68** 95% CI: 1.12-2.53), and eating a Western diet, i.e. a diet high in meat, refined grains, high-fat foods, and fast foods, (**OR: 2.15** 95% CI: 1.06-4.35)

Even further from concrete!

$$\frac{\dfrac{P(C|family)}{1-P(C|family)}}{\dfrac{P(C|control)}{1-P(C|control)}}$$

Individual vs. Population-based Decision

➮ Lump noticed on 7-year-old's leg

➮ Doctor recommends surgery to rule out cancer

Individual vs. Population-based Decision

- Lump noticed on 7-year-old's leg
- Doctor recommends surgery to rule out cancer
- Dueling risks
  - 1 in 1,000,000 lumps found on children's legs cancerous
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- What is the "right" decision?
  - Imagine you are the parent.
  - Imagine you are the doctor.
  - Imagine you are public health analyst.

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- Dueling risks
  - 1 in 1,000,000 lumps found on children's legs cancerous
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- What is the "right" decision?
  - Parent: *Surgery 1000 times as likely to cause adverse event*
  - Doctor: *How many instances like this before first case of cancer?*
 - Public health analyst: *Total lives saved by surgeries?*

Probabilistic Illusions:
"Optical" Illusions of Chance Perception

➡ What is Probability, Really?

➡ Neglected Base Rates

➡ Transposed Conditionals

➡ "What Are The Chances?!" Hindsight Bias

What is Probability, Really?

➡ Where do probabilities *reside*? Properties of what?

➡ Out there in the world? In physical objects (propensities)
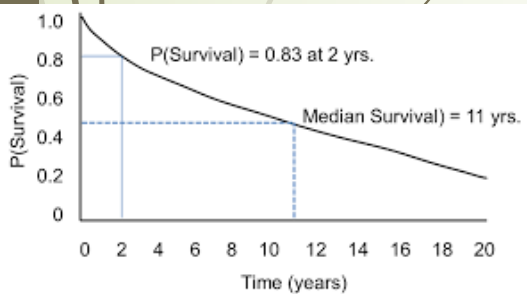
➡ Observed regularities under repetition? (relative frequencies)

P(Survival) = 0.83 at 2 yrs.

Median Survival) = 11 yrs.

➡ In our minds? Characterizing our uncertainty (degrees of belief)

Neglected Base Rates

➡ Inspiring racist threat assessment

"I mean, look, Bill, I'm not a bigot. You know the kind of books I've written about the civil rights movement in this country," Williams replied. "But when I get on the plane, I got to tell you, if I see people who are [bald] and I think, you know, they are identifying themselves first and foremost as [bald people], I get worried. I get nervous."

– Juan Williams

General Flynn ✔
@GenFlynn

⚙ | ☺+ Follow

Fear of baldies is RATIONAL: please forward this to others: the truth fears no questions...

Neglected Base Rates Hypothetical Example

- 4% of Americans shave their heads

- Suppose that, of 200 attackers involved in terrorist attacks in U.S. from 2002 to 2011, 86 of these individuals (43%) were completely bald.

- One politician suggests that we don't allow bald people fly "until we can figure out what the heck is going on."

Neglected Base Rates Hypothetical Example

➡ Since bald people are so over-represented among terrorists, it's only rational to be more afraid of people *without* hair than *with* hair, right?

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➡ P(bald | terrorist) high ↛

P(terrorist | bald) is high!

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P(terrorist | bald) is high!

➡ 210 million adults; 8 million bald

➡ 86 of 8 million bald adults =   0.001075%

➡ 114 of 202 million non-bald = 0.000056%

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19 times more likely to be terrorist than man in photo above?
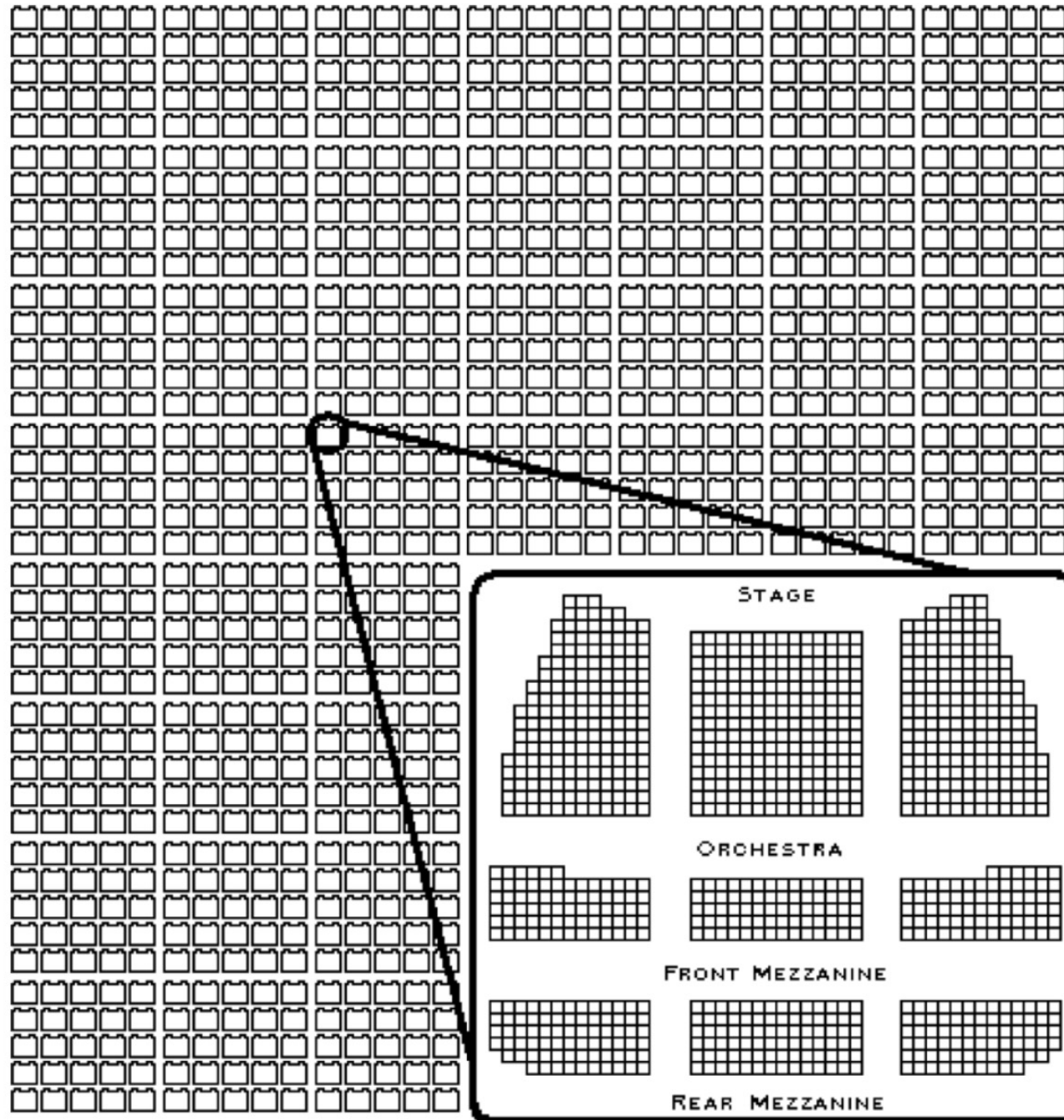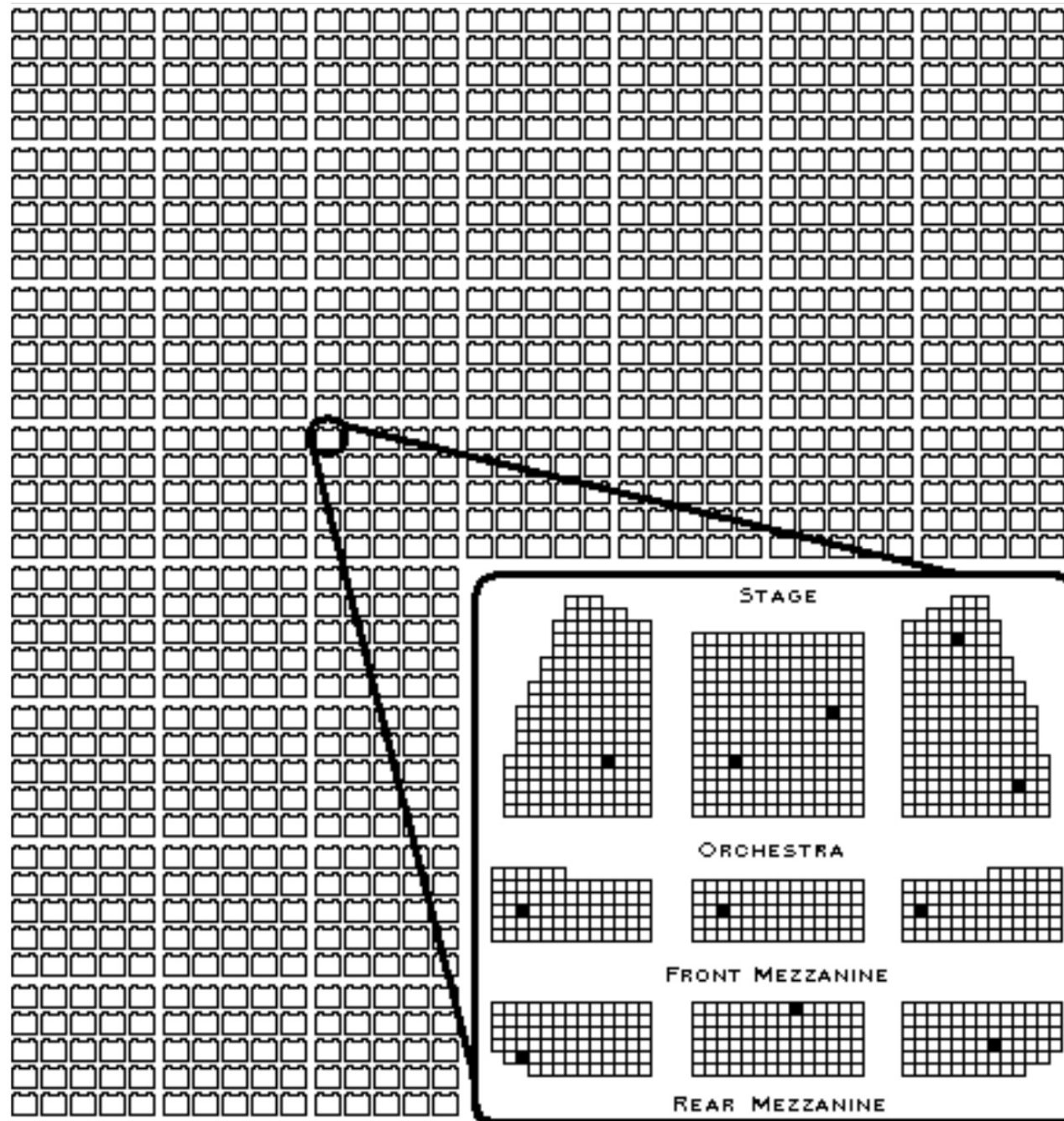
C. zero darkened seats in 1,000 RCTs - risk is less than 1/1,000,000

Probability of being terrorist if not bald

Fewer than one per million

78

B. 12 darkened seats in 1,000 RCTs - risk is 12/1,000,000

Probability of being terrorist if bald

Fewer than a dozen per million

Neglected Base Rates
Bottom Line

➡ Prob(terrorist | characteristic X) = extremely low

  ➡ For virtually any X except concrete evidence of plans

➡ Error of neglected base rates serves to excuse irrational fear of unfamiliar or those already disfavored

  ➡ Otherwise, we would all avoid *men* as likely violent criminals.

Transposed Conditionals

➡ A crime has been committed and the criminal's blood was left at the scene.

➡ Only 1 per 1000 people has the same blood type as the criminal.

➡ A person on trial for the crime has this blood type.

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  - The chance of an innocent person having the matching blood type is just 1 in 1000.
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  - Thus, the probability they are innocent is just 1 in 1000.

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    ➤ The accused has that blood type.

    ➤ Thus, the probability they are innocent is just 1 in 1000.

➤ What is wrong with this reasoning?

    ➤ Probability of blood type given innocence = 1/1000

    ➤ Probability of innocence given blood type is not the same

    ➤ Why was the accused a suspect?

        ➤ Other evidence? How many suspects' blood tested?

        ➤ DNA database?

Transposed Conditionals

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  - Probability of innocence given blood type is not the same
  - Why was the accused a suspect?
    - Other evidence? How many suspects' blood tested?
    - DNA database?
- The criminal is determined to be from Houston.
  - 2.3 million people in Houston
  - Suppose 500,000 are eligible suspects
    - 500 people with same blood type left by criminal
   - P(innocent | matching blood type) = 499/500 = 99.8%

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    ➤ 500 people with same blood type left by criminal

    ➤ P(innocent | matching blood type) = 499/500 = 99.8%

Chance they are guilty same as sitting in a black seat by chance

STAGE

ORCHESTRA

FRONT MEZZANINE

REAR MEZZANINE
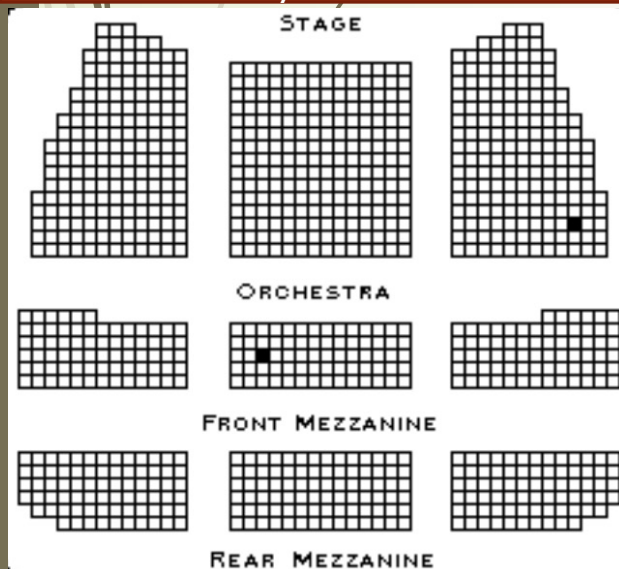
"What Are The Chances?!"
Can't be a coincidence!
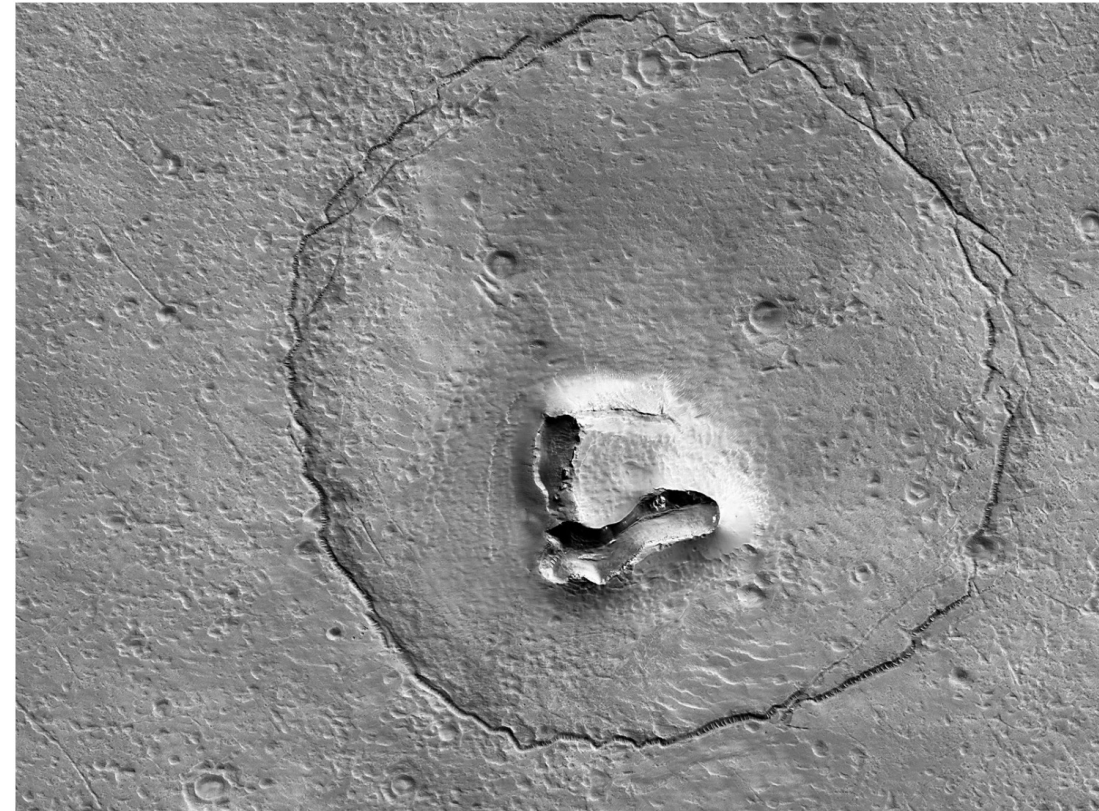
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A NASA spacecraft discovers a formation on Mars resembling a bear

January 29, 2023 · 5:00 AM ET

GIULIA HEYWARD

A man in Massachusetts has won $1 million in the lottery for the second time

By Ryan Prior, CNN
Updated 8:17 PM EDT, Fri November 1, 2019

Lucky lottery winner: Nebraska man wins jackpot for second time this year

Woman wins big in lottery for a second time

By Steve Rogers - November 4, 2020

TRENDING

Idaho woman wins back-to-back, six-figure lottery prizes

By Josh K. Elliott · Global News
Posted February 8, 2021 3:42 pm

Florida man wins $5 million from scratch-off ticket -- his second lotto jackpot in three years

By Fox 13 News staff | Published December 1, 2020 | Florida | FOX 13 News

INJURED?

CAR ACCIDENT

TRUCK ACCIDENT

NEWS

Monroe County man wins $4M lottery jackpot for second time

How Likely Are Coincidences?

Bulgarian lottery repeat probed

The Bulgarian authorities have ordered an investigation after the same six numbers were drawn in two consecutive rounds of the national lottery.

The numbers - 4, 15, 23, 24, 35 and 42 - were chosen by a machine live on television on 6 and 10 September.

An official of the Bulgarian lottery said manipulation was impossible.

The chance of the same numbers appearing were one in four million

A mathematician said the chance of the same six numbers coming up twice in a row was one in four million. But he said coincidences did happen.

Minister of Physical Education and Sport Svilen Neykov said the commission established to investigate would provide answers towards the end of the week.

The lottery organisers described it as a freak coincidence and pointed out that the numbers were drawn in a different order.
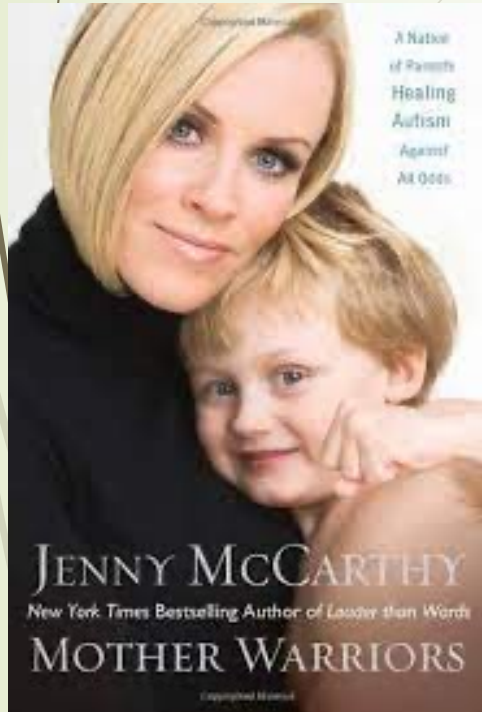
Nobody won the top prize in the first draw.

But a record 18 people guessed all six numbers in the 10 September draw.

Each will win 10,164 leva (£4,700).

Coincidence expected in large population seems like evidence to individual experiencing it

➤ Oprah finished with a statement from the CDC, which said there was no science to support the connection between vaccines and autism. I couldn't help but think, "Who needs science when I'm witnessing it every day in my own home? I watched it happen." I replied with all the love that I could muster in my heart. "At home, Evan is my science."

–Jenny McCarthy

➤ 10 million MMR vaccines per year (~age 1 and 4-6 yrs)

➤ 1 in 27 boys diagnosed with autism

   ➤ How many will begin showing signs by chance, after vaccination?

   ➤ How many parents more sensitive to signs after vaccination?

Bayes' Rule Via Natural Frequencies
No fractions, no formula

➡ Suppose: One in a thousand people has a particular form of congenital heart condition. There is a test to detect it.

➡ The test is 99% accurate for those with the defect and 95% accurate for those without it.

➡ A randomly selected person is screened for the condition at an annual physical and tests *positive*.

➡ Probability that this person in fact has the disease?

Bayes' Rule Via Natural Frequencies
No fractions, no formula

- Of 100,000 people…
  - 100 have the heart condition
  - 99,900 do not have the condition
- Screenings advised; not based on symptoms

Bayes' Rule Via Natural Frequencies
No fractions, no formula

- Of 100,000 people…
  - 100 have the heart condition
  - 99,900 do not have the condition
- Expected results for those with heart condition
  - 99 correctly diagnosed (+)
  - 1 misdiagnosed as fine (–)
- Expected results for those *without* heart condition
  - 94,905 correctly test (–) and breathe sigh of relief
  - 4,995 misdiagnosed (+) as having heart defect

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- Expected results for those *without* heart condition
  - 94,905 correctly test (–) and breathe sigh of relief
  - 4,995 misdiagnosed (+) as having heart defect
- Your test comes back (+). Oh no! And it has such high accuracy.
  - But you are among 99 + 4995 = 5094 to test positive
  - Only 99 of 5,094 people have the genetic mutation.
  - Very unlikely you have it: 2%, like guessing a single card from deck!

Recommendations

- Natural Frequencies and Concrete Comparisons

- Absolute Risk Comparisons

- Transparency about Uncertainty (or at least "according to our best current knowledge")

- Probability is *always* conditional—Know upon what

- Good decisions will result in bad outcomes.

  - Doesn't mean decision was wrong (hindsight bias)

  - Help inoculate against magical thinking ("If only…")

  - Chasing elusive certainty doesn't work; can be harmful

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Thank You!