

When five out of four people have trouble with fractions

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AIP Assembly of Society Officers □ March 28, 2019



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Ruth



Ruth

Math doesn't
come easy for me
and never has

The numbers
on the page were
overwhelming and
my mind
went blank

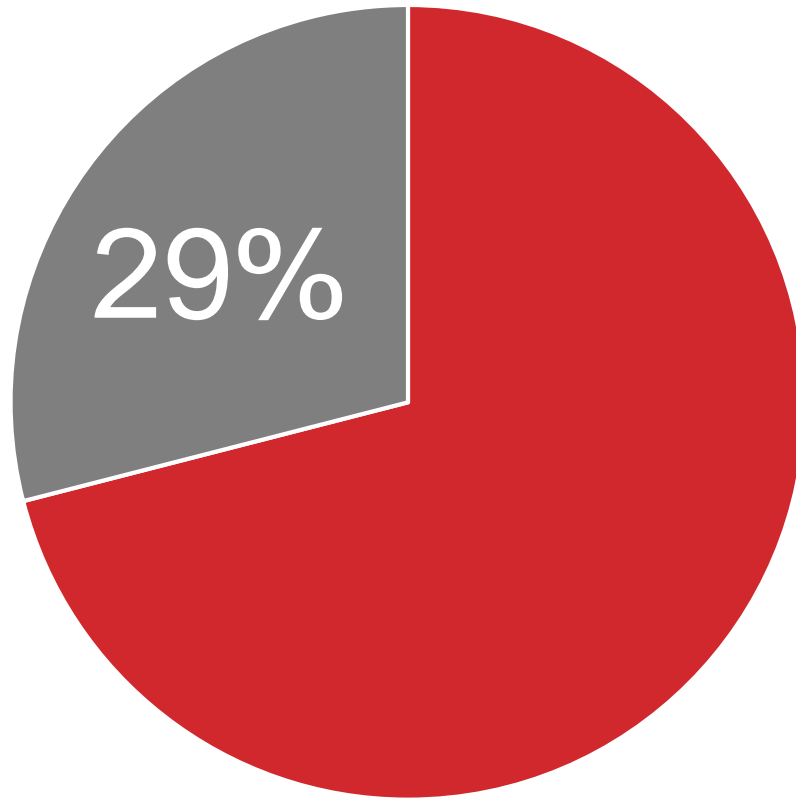
I always got
nervous, anxious,
and almost panicked
when I
see numbers

**I am not a
math person**

I have
never gotten along
well with numbers,
so don't use
them too much



How many people are innumerate?



Objective Numeracy

Which of the following numbers represents the biggest risk of getting a disease?

1%, 10%, or 5%

Answer: 10%

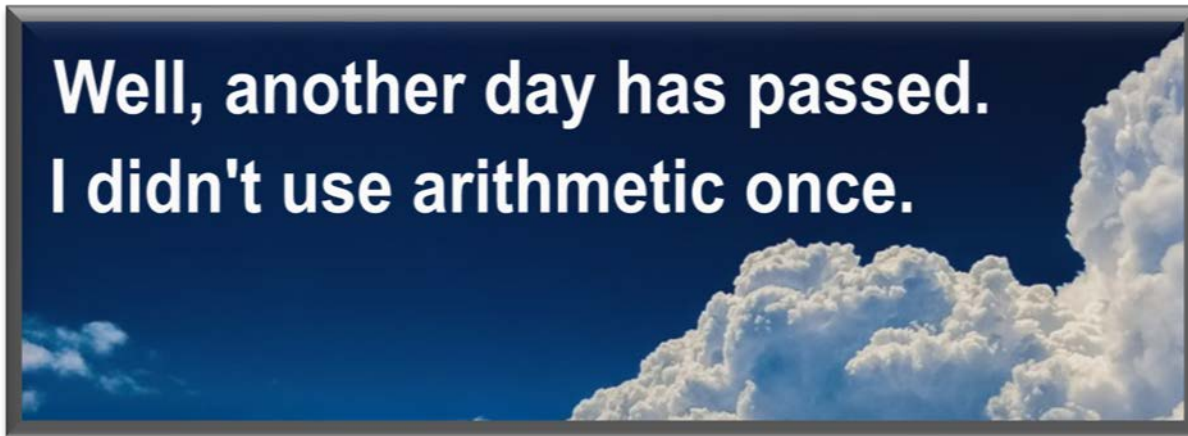


Objective Numeracy

The chance of winning a car is 1 in 1000.
What percentage of tickets win a car?

Answer: 0.1%





Is numeracy important?



The less numerate lack knowledge to manage their health

40% don't know

Rx Pharmacy

Take one tablet on an empty stomach one hour before a meal or two to three hours after a meal unless otherwise directed by your doctor

33% don't know



Not understanding has consequences

I miscalculated how long a prescription medication would last. I ran out of pills and ... ended up very ill

Master's degree

I had been diagnosed with cancer ...
[The test result] numbers were very confusing....
I felt scared

PhD



The less numerate make worse decisions

The more numerate think hard about numbers

The less numerate are vulnerable to the power of compelling stories, images, and emotions



Two fundamentally different, often conflicting, types of information

Experienced beliefs and emotions: All of us
Data-based information: Sometimes and some of us

The highly numerate make more data-based decisions

The less numerate perceive greater risk and make worse decisions



**The risks of being less
numerate accumulate
over time**



The less numerate are less healthy



Drugs

40% more likely to have at least one disease



They are also less wealthy



\$200,000

vs.

\$1,700,000



15% less likely to own stock



**There are
3 kinds
of people:**

**Those who
can count
and those
who can't.**



My second lesson from Ruth



Numeric confidence questions

How good are you at calculating
a 15% tip?

How good are you at working
with fractions?



**People aren't always
accurate about who they
are as a math person**



People aren't always accurate about who they are as a math person

Lower
objective
numeracy

Higher
objective
numeracy

Lower
confidence



Higher
confidence



Why does numeric confidence matter?

Persistence and interest



There are different ways to be “numerate”

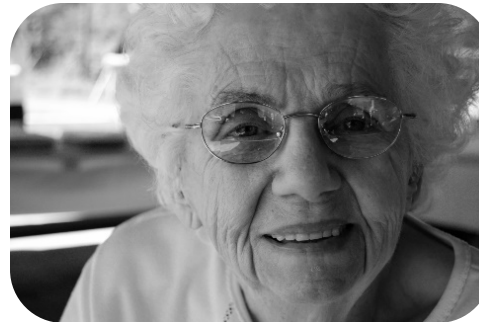
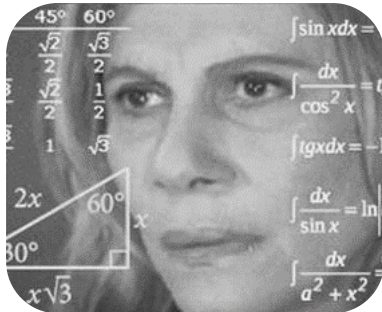
Objective numeracy

Numeric confidence



Communication matters

Especially to more vulnerable populations



Summary: Evidence-based practices

1. Identify communication goals
Then choose information presentation techniques strategically
2. Provide numbers
3. Reduce cognitive effort for the public



Peters, E., Meilleur, L., & Tompkins, M.K. (2014)
Commissioned by the Institute of Medicine

Summary: Evidence-based practices

1. Identify communication goals
Then choose information presentation techniques strategically
2. Provide numbers
3. Reduce cognitive effort for the public
4. Call attention to the most important information
5. Provide experiential cues, particularly when information is unfamiliar or avoidable

Peters, E., Meilleur, L., & Tompkins, M.K. (2014)
Commissioned by the Institute of Medicine



Offer more help

The doctor says:
"Your INR level is 4.3. Please take your medication differently. Decrease your dose to 5mg tablets, 1½ tablets M, W, F and a full one the other days."

The less numerate patient:
"Your INR ☺**☺ ☺ ☒ ----
P'hN. Please take your medication differently.
Decrease your dose to p ≠ °
~ ∴ ☺ ☐ ---- G M ☐
~ ∴ ☺ ☐ ---- éG œG í
~ ↘ ☺ ~ ☐ ** ☺ ☺ ↗ ↘ ☺
the other days."



Offer more help

The doctor says:
"Your INR level is 4.3. Please take your medication differently. Decrease your dose to 5mg tablets, 1½ tablets M, W, F and a full one the other days."

The doctor could say:
"Your INR is too high. Please take your medication differently. Use 5mg tablets and do the following:
Mon
Tues
Wed
Thurs
Fri
Sat
Sun"



Offer more help

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"Your INR level is 4.3. Please take your medication differently. Decrease your dose to 5mg tablets, 1½ tablets M, W, F and a full one the other days."

The doctor could say:

"Your INR level is too high. Please take your medication differently. Use 5mg tablets and do the following:

Mon  + 

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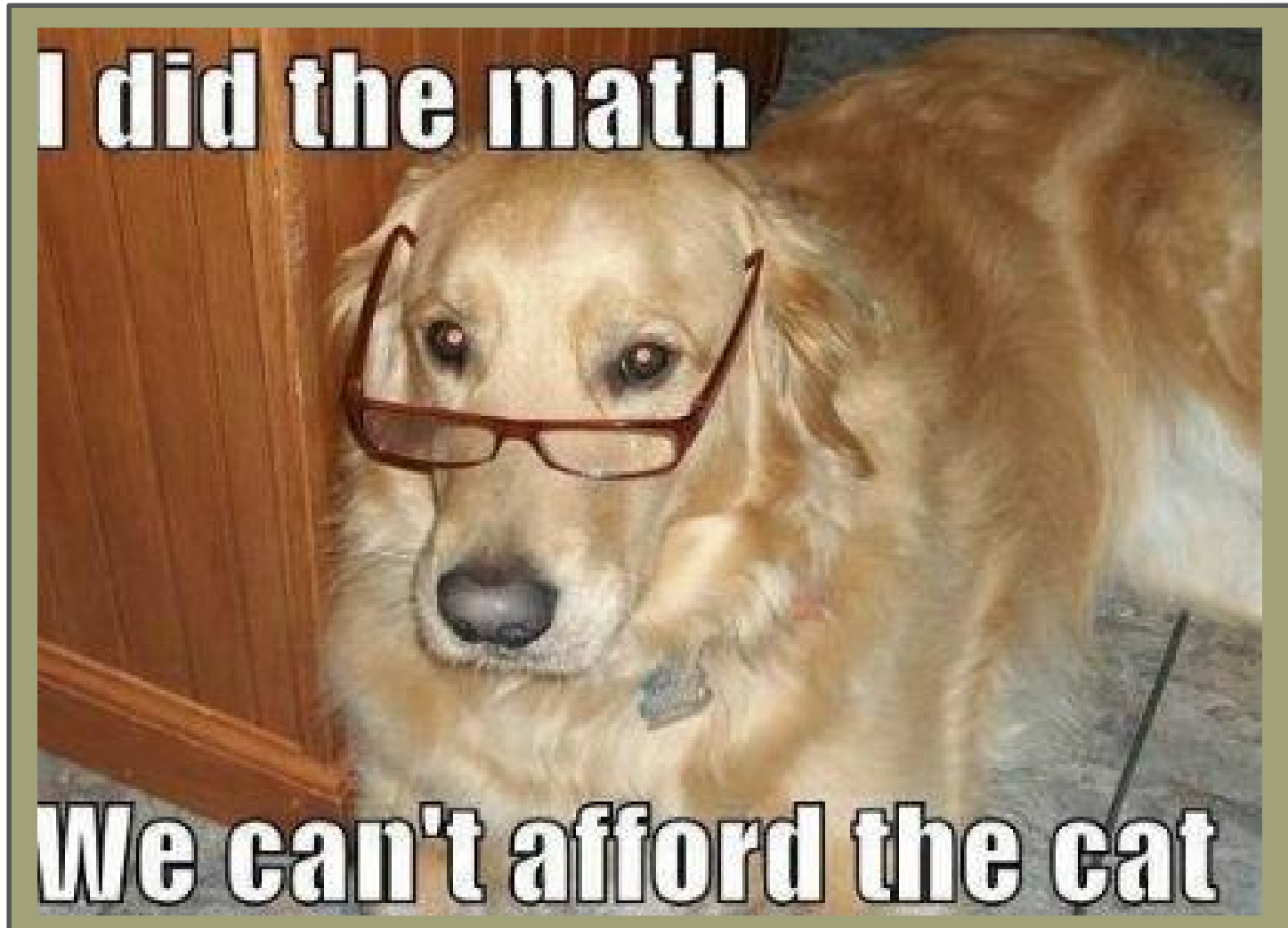
Sat 

Sun 



A Problem:

The goal is not always accuracy



“Being a motivated reasoner takes effort” (Taber & Lodge, 2006)

- We are motivated reasoners all the time
 - Accuracy
 - Avoid pain of numbers
 - A priori beliefs and/or social connections
- The highly numerate
 - “Better” motivated thinkers
 - More politically polarized (e.g., climate change, nuclear power)
 - Greater knowledge resistance (e.g., gun control)

Kahan & Peters (2017)

Kahan, Peters, Dawson, & Slovic (2017)

Kahan, Peters, Wittlin, Slovic, Oullette, Braman, & Mandel (2012)



Communication matters

How can we encourage scientific accuracy as a goal when other goals are salient?

- Among the less numerically confident
- In politically divisive domains



Conclusions

Modern science is amazing

But human beings are the ultimate actors

**Key are communication and
enhancing public numeric
literacy and confidence!**



Thank you!

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My forthcoming book:
Innumeracy in the Wild,
Oxford University Press

