When five out of four people have trouble with fractions

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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 am not a math person

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

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

I have never gotten along well with numbers, so don’t use them too much
How many people are innumerate?

29%
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%
Well, another day has passed. I didn't use arithmetic once.

Is numeracy important?
The less numerate lack knowledge to manage their health

40% don’t know

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

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 confidence

- Higher objective numeracy
- Lower 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

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

Commissioned by the Institute of Medicine
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 ÷ 4.3. Please take your medication differently. Decrease your dose to 5mg ÷ 1½ tablets M, W, F and a full one the other days."
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

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 level is too high. Please take your medication differently. Use 5mg tablets and do the following:
Mon ❌ + ❌
Tues ❌
Wed ❌ + ❌
Thurs ❌
Fri ❌ + ❌
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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