How to talk about mathematics

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My background

TV show: Eureka

Scores in five world championships

	0	1	2	3	4	5	6	7	8
0	25								
1	66	35							
2	39	54	9						
3	21	19	13	1					
4	10	6	1						
5	2								
6	1	2							
7	1								
8	1								

The deficit model

Image: Sidney Harris

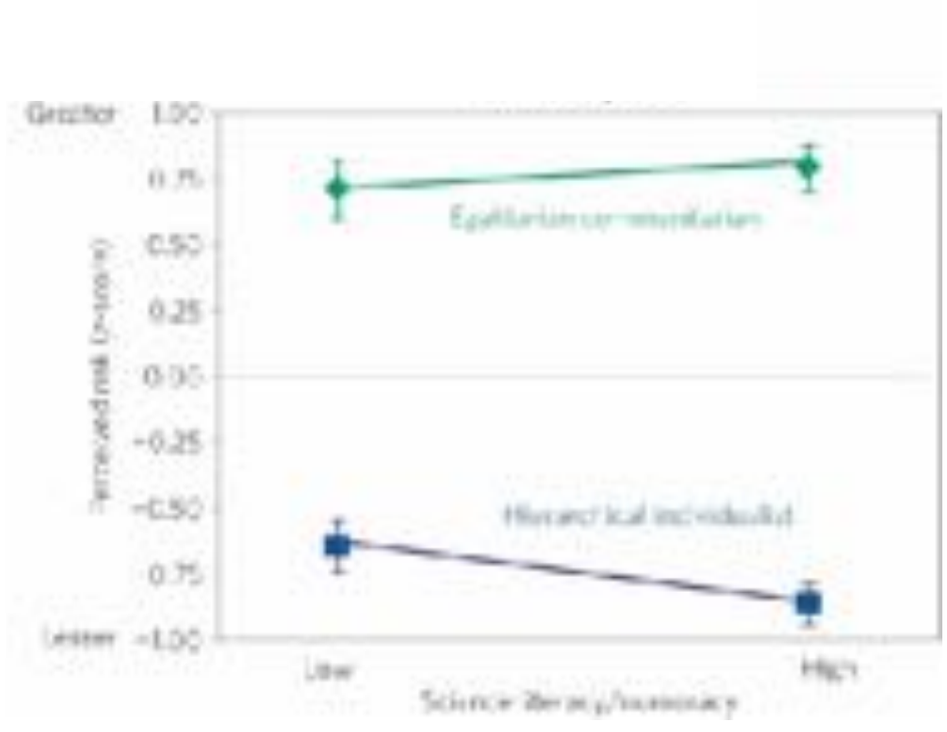
Deficit model

- Basic idea: if you give people more knowledge, they will embrace the facts.
- Backfires in many occasions.
- Enhances polarization between groups.

Example: more information about vaccines does not convince parents

Image:Peter Lewis - DFID

Example: more science literacy enhances polarization in climate change debate.



Kahan, Dan M., et al. "The polarizing impact of science literacy and numeracy on perceived climate change risks." Nature climate change 2.10 (2012): 732-735.

‘We just give them the numbers’

Outbreak of Asian flue expected to cost 600 lives

Image: Nikolay Olkhovoy

- Strategy A: 200 people will be saved
- Strategy B: there is a 1/3 probability that 600 people will be saved, and a 2/3 probability that no people will be saved

72% of participants prefers strategy A

- Strategy A: 400 people will die
- Strategy B: there is a 1/3 probability that nobody will die, and a 2/3 probability that 600 people will die

Suddenly 78% of participants prefers strategy B

Audience First!

Simpsons paradox

Discrimination at Berkeley

Data Berkeley 1973

	Men	Women
Applications	8842	4321
Admitted	44%	35%

Data Berkeley 1973 - a closer look

Department	Men		Women	
	Appli-cations	Admitted	Appli-cations	Admitted
A	825	62%	108	82%
B	560	63%	25	68%
C	325	37%	593	34%
D	417	33%	375	35%
E	191	28%	393	24%
F	272	6%	341	7%

Data Berkeley 1973

	Men	Women
Applications	8842	4321
Admitted	44%	35%

Simpsons paradox:

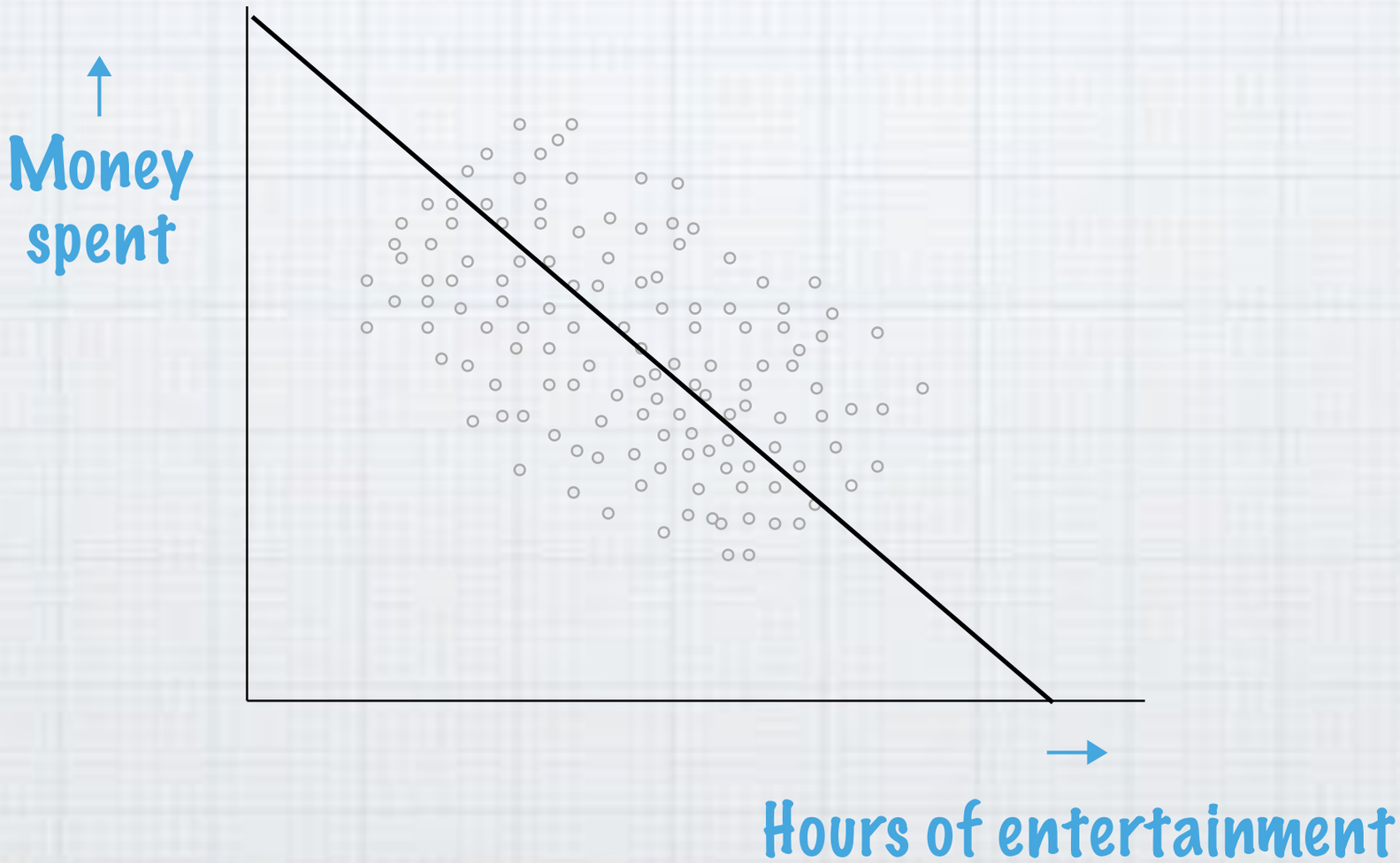
A trend in different groups is reversed when the groups are combined.

Kidney stones

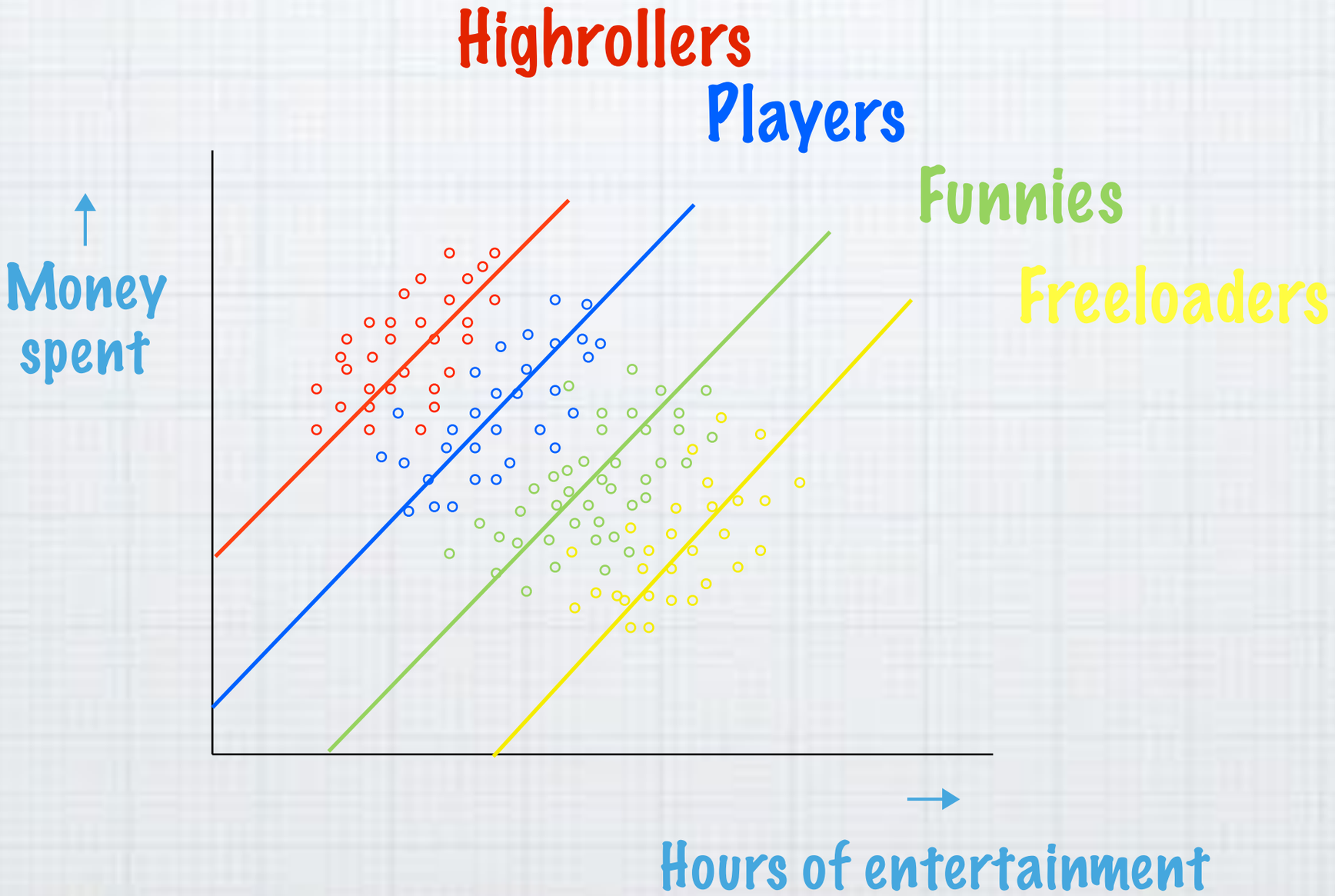
Batting averages

Image: Keith Allison

Holland Casino



Holland Casino



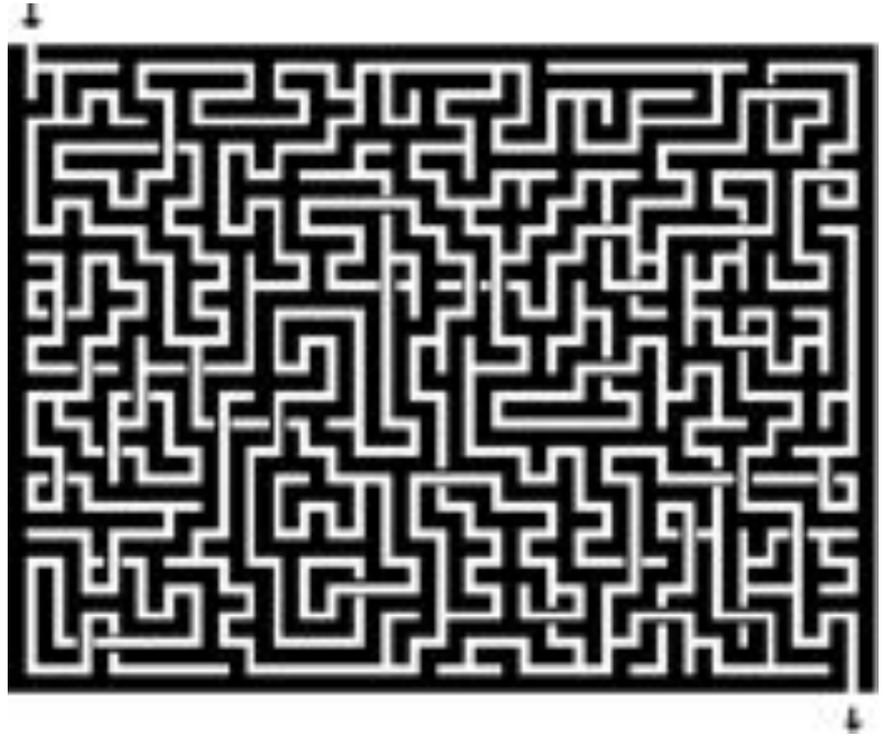
Narrative

Outline

- Introduction (theory & literature)
  - TiN coating properties, improvement TiN properties
  - Fullerenes: WS_2 (shortly), C_{60} (tribological properties)
  - Deposition processes (Vacuum arc, Effusion cell)
- Project goals
- Experimental apparatus and procedure
- Results and discussion
- Summary and conclusions
- Open questions and recommendations

Outline of this talk

- Introduction about Pythagoras



- Conclusions

Narrative tricks

- sensory language
- conjunctions
- connectivity
- appeal to the reader

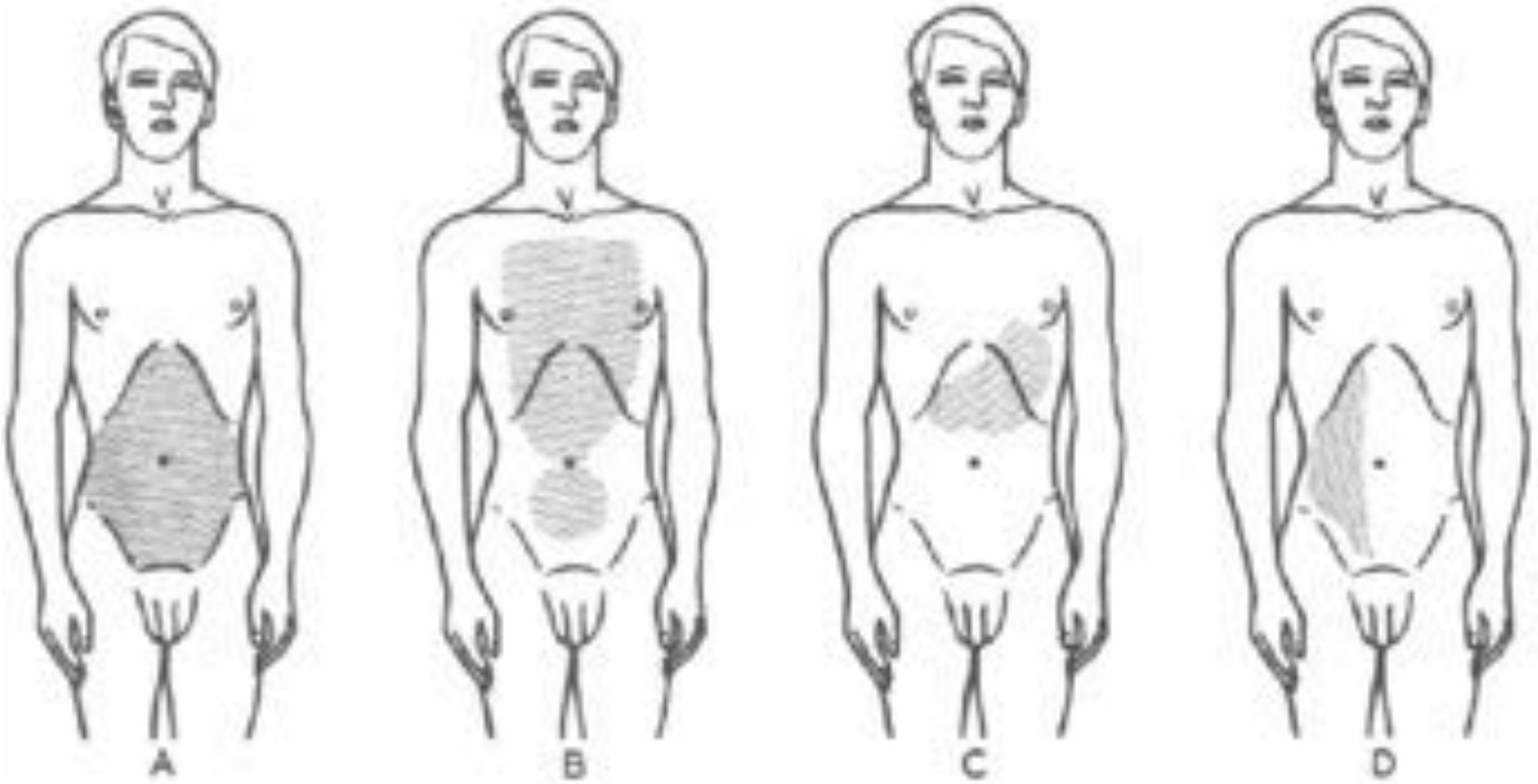
Image: Philip Scalia

A great start

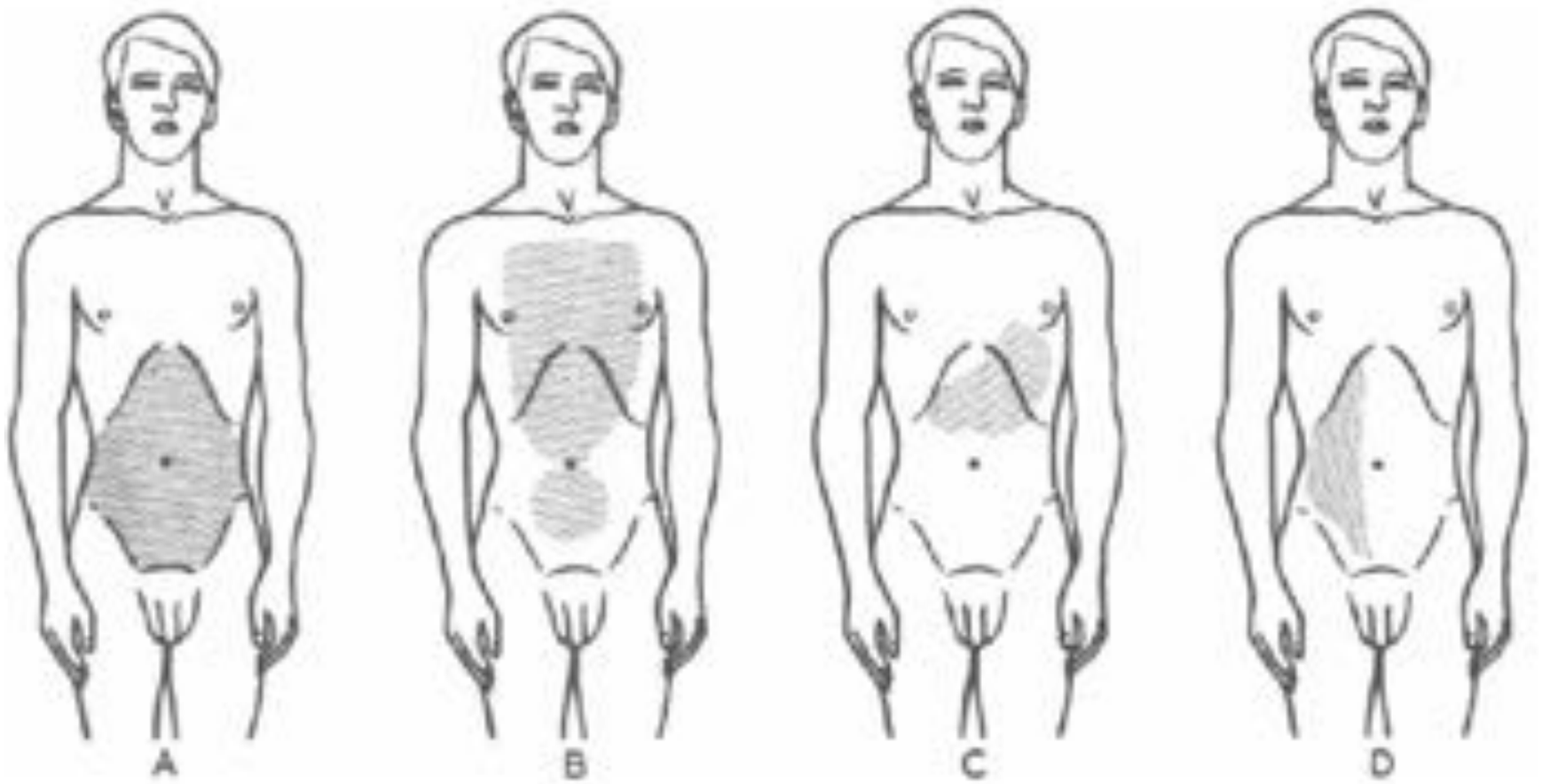

MARCUSduSAUTOY

Jargon

Position of the stomach



Results from patients



59% 19% 20% 2%

The test is positive

Word	Scientist thinks of	General public thinks of
chaos	system very sensitive to small changes	their garage
robot	machine for some task	terminator
theory	best explanation of the facts	just another opinion
x	a variable	a kiss
model	simplified version of reality	Phaedra Hoste

Pilot study: geophysics

Images: Apollo 17, John McColgan, Jiri Büller

Survey for experts and laymen

15. Which of the following photos is, in your opinion, the best depiction of a flood?

A.

B.

C.

D.

What is a river?	Lay people (N = 119)	Experts (N = 34)
Path of fresh water flowing into the ocean	71%	9%
Water flowing only on the surface of the land and never underground	4%	3%
Large stream which serves as the natural drainage for a basin	15%	88%
Flow of surface water within a straight channel	10%	0%

Next plan: do something similar for words used to describe probabilities in the media.

A special kind of jargon

$$\rho\left(\frac{\partial u}{\partial t} + u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y} + w\frac{\partial u}{\partial z}\right) =$$

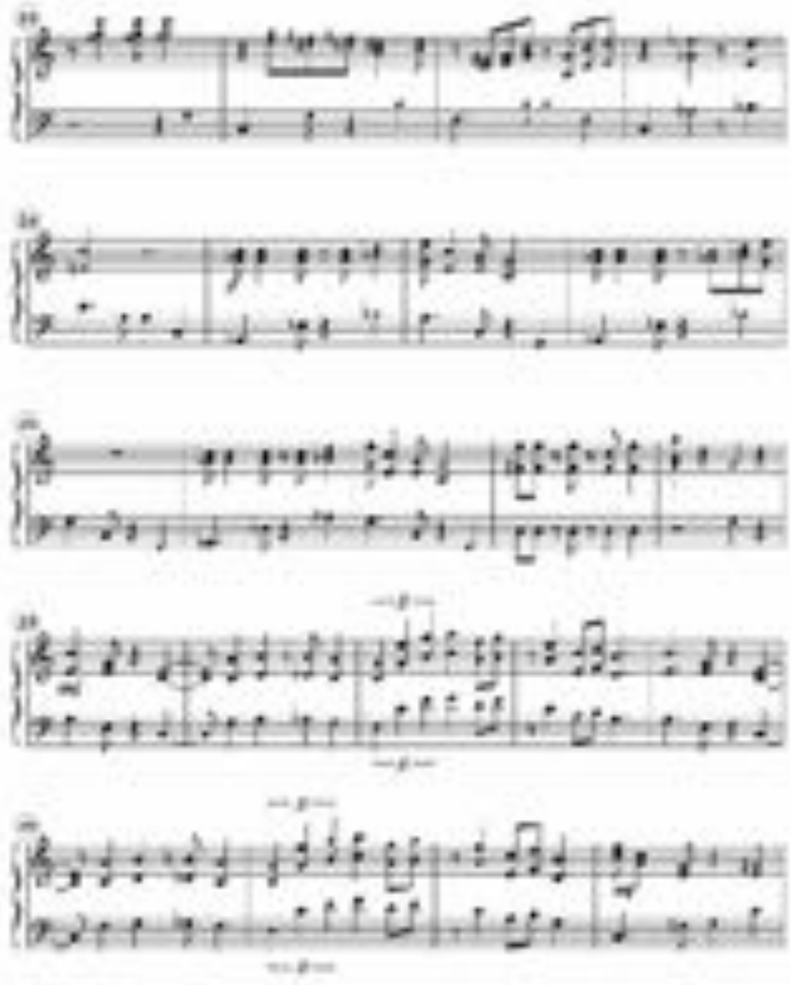
$$\rho g_x - \frac{\partial p}{\partial x} + \frac{\partial}{\partial x}\left[2\mu\frac{\partial u}{\partial x} + \lambda\nabla\cdot\mathbf{V}\right] + \frac{\partial}{\partial y}\left[\mu\left(\frac{\partial u}{\partial y} + \frac{\partial v}{\partial x}\right)\right] + \frac{\partial}{\partial z}\left[\mu\left(\frac{\partial w}{\partial x} + \frac{\partial u}{\partial z}\right)\right]$$

$$\rho\left(\frac{\partial v}{\partial t} + u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y} + w\frac{\partial v}{\partial z}\right) =$$

$$\rho g_y - \frac{\partial p}{\partial y} + \frac{\partial}{\partial y}\left[2\mu\frac{\partial v}{\partial y} + \lambda\nabla\cdot\mathbf{V}\right] + \frac{\partial}{\partial z}\left[\mu\left(\frac{\partial v}{\partial z} + \frac{\partial w}{\partial y}\right)\right] + \frac{\partial}{\partial x}\left[\mu\left(\frac{\partial w}{\partial y} + \frac{\partial v}{\partial x}\right)\right]$$

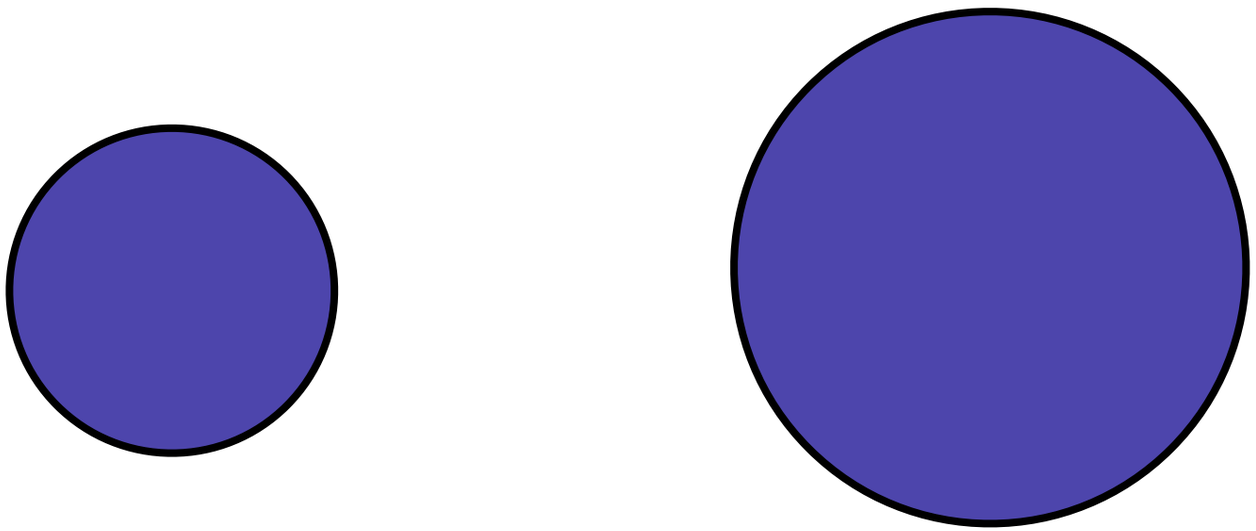
$$\rho\left(\frac{\partial w}{\partial t} + u\frac{\partial w}{\partial x} + v\frac{\partial w}{\partial y} + w\frac{\partial w}{\partial z}\right) =$$

$$\rho g_z - \frac{\partial p}{\partial z} + \frac{\partial}{\partial z}\left[2\mu\frac{\partial w}{\partial z} + \lambda\nabla\cdot\mathbf{V}\right] + \frac{\partial}{\partial x}\left[\mu\left(\frac{\partial w}{\partial x} + \frac{\partial u}{\partial z}\right)\right] + \frac{\partial}{\partial y}\left[\mu\left(\frac{\partial w}{\partial y} + \frac{\partial v}{\partial z}\right)\right]$$

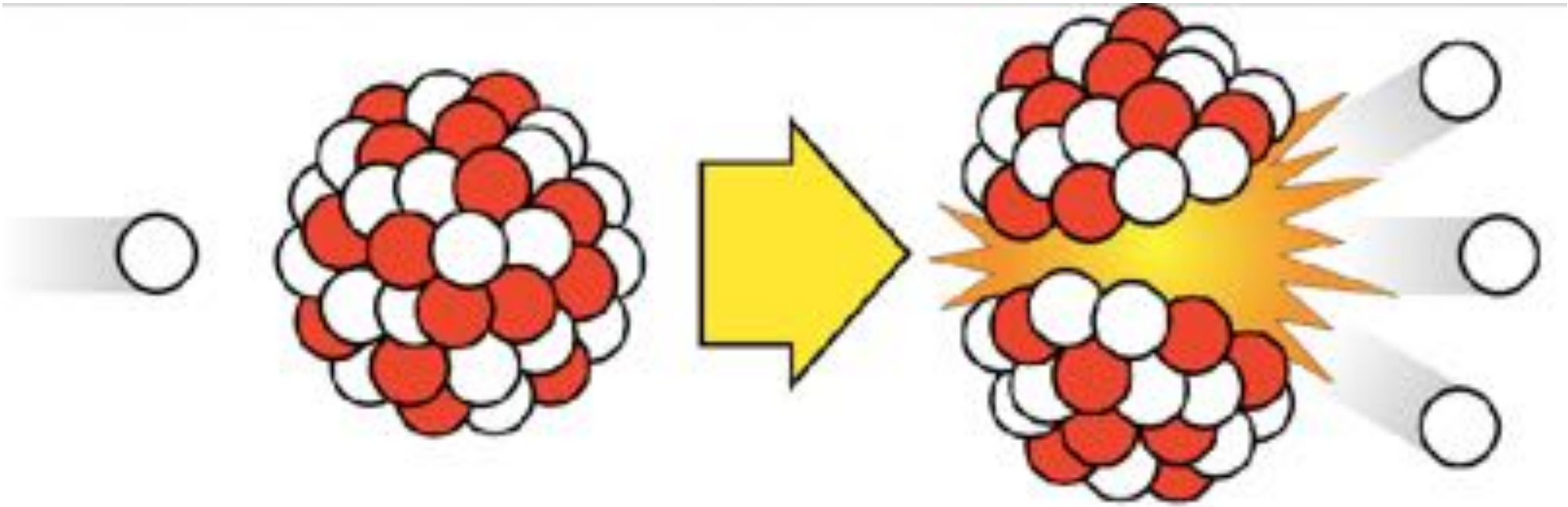


Science communication is like a caravan - about metaphors.

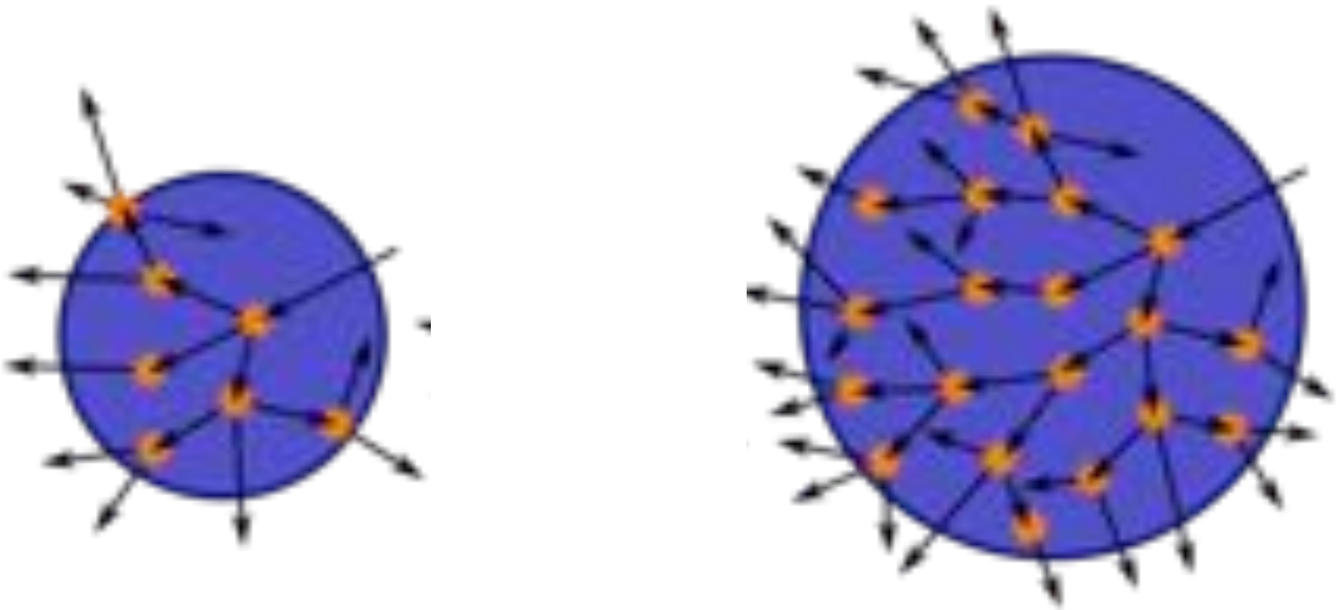
Critical mass



Chain reaction



Chain reaction



Very short summary

- Science communication is more than just lecturing the public about your work.
- Always put your audience first.
- Steal narrative tricks from writers and film makers.
- Think about how subtle jargon can be.
- Use mousetraps and pingpong balls if you can.