

How to be wrong

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Slides in this presentation are from material kindly provided by
Shannon Ellis and Brad Voytek

**Guest lecture
Mon Dec 4th 2PM
Peterson 110**

NO CLASS FOR 9AM LECTURE!!!

MUST BE PRESENT TO GET EC!!

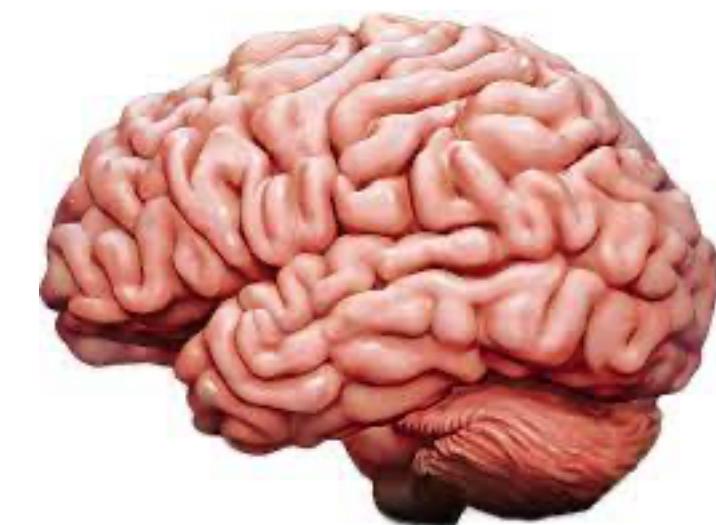
Errors of measurement



Errors of analysis

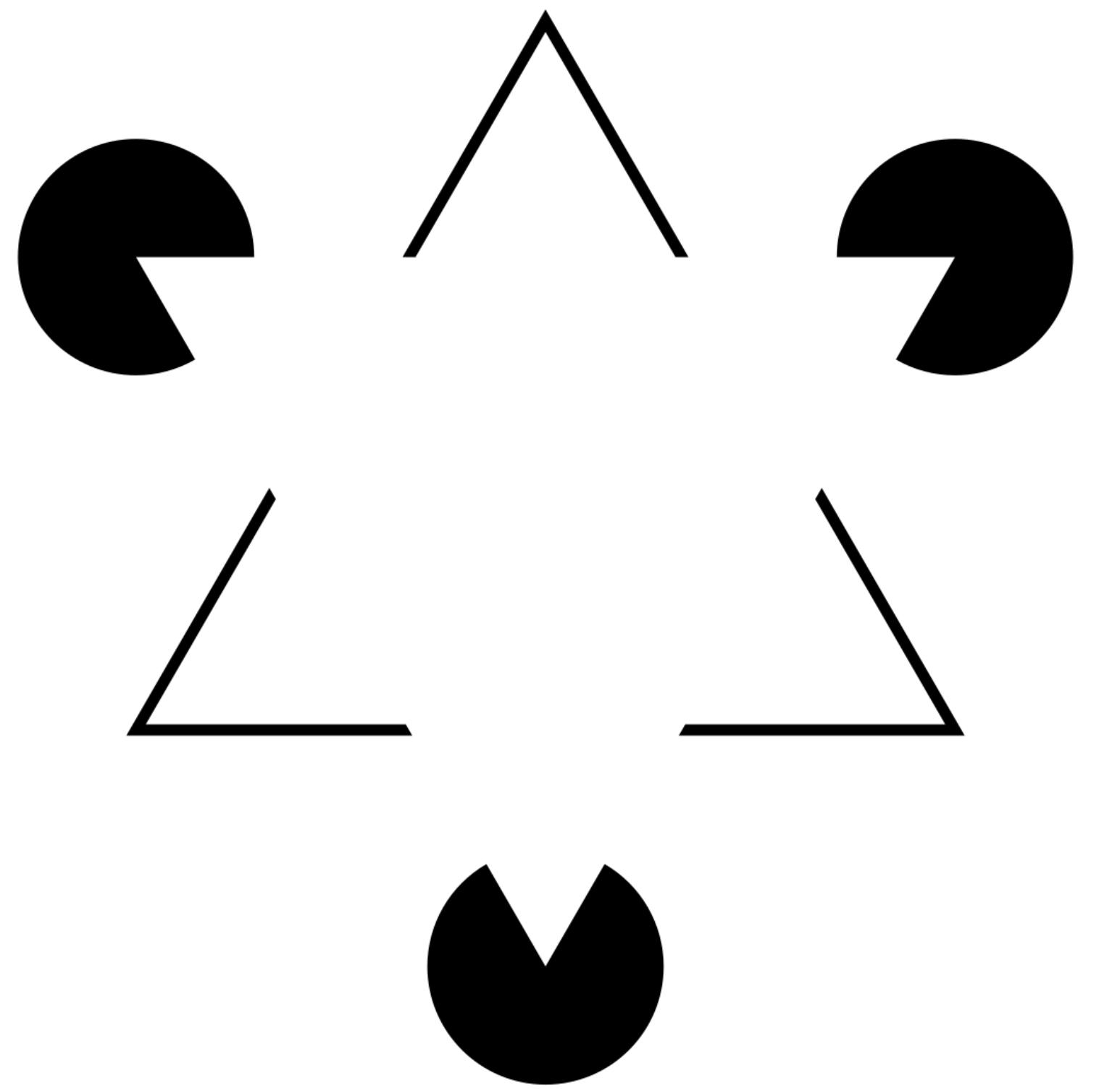
Errors of broken tools

Errors of human cognition



Errors of communication





Exercise 1A

East side of room



Exercise 1B

West side of room

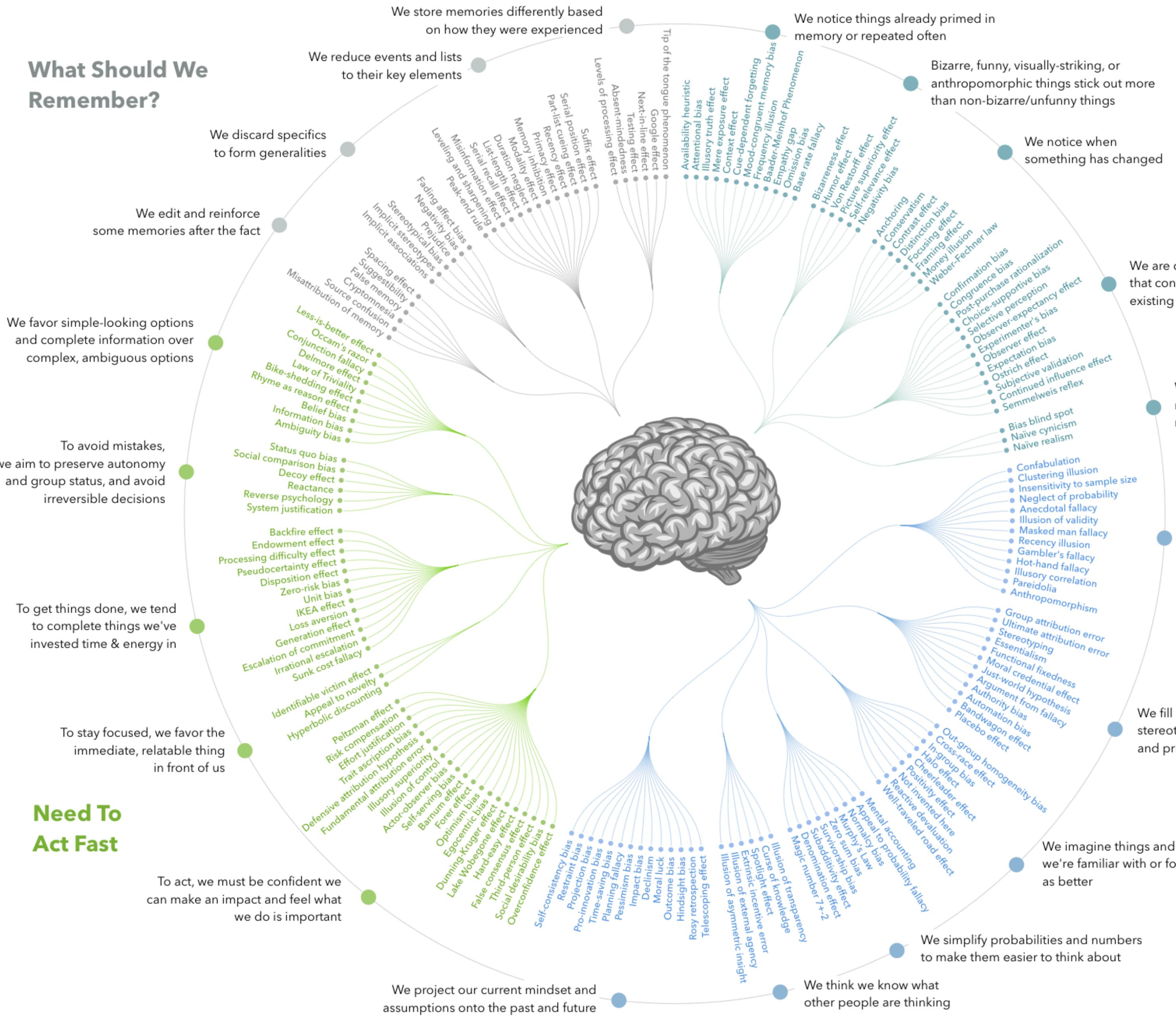


Anchoring bias

- The tendency for decision makers to start their decision process from a specific point of reference and subsequently make insufficient adjustments from the anchored point.
- Possible techniques to reduce this bias:
 - Document the rationale for a decision
 - Learn to anticipate and correct the bias
 - Develop your own expectations through experience

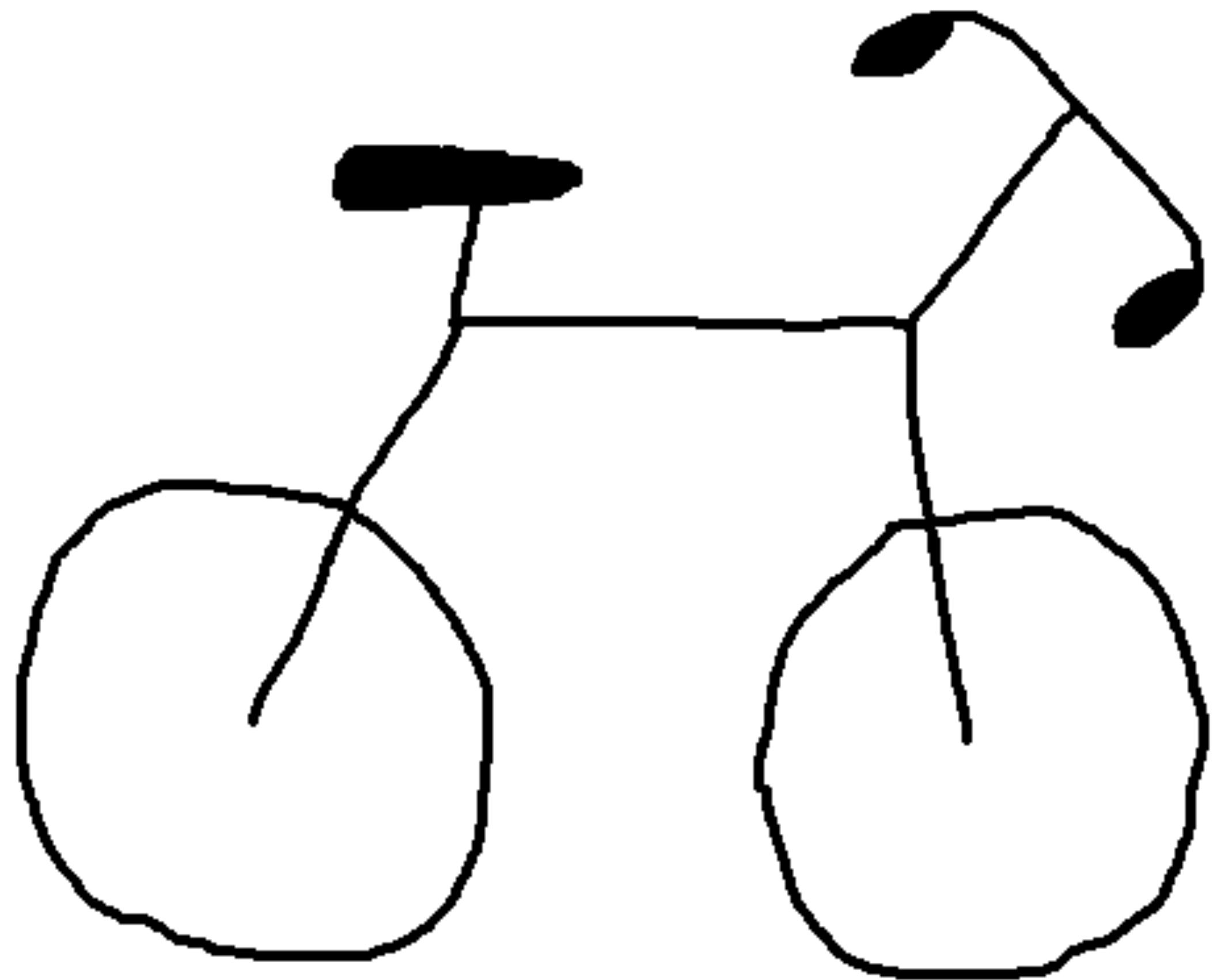
COGNITIVE BIAS CODEX

What Should We Remember?



Exercise 2





Frame

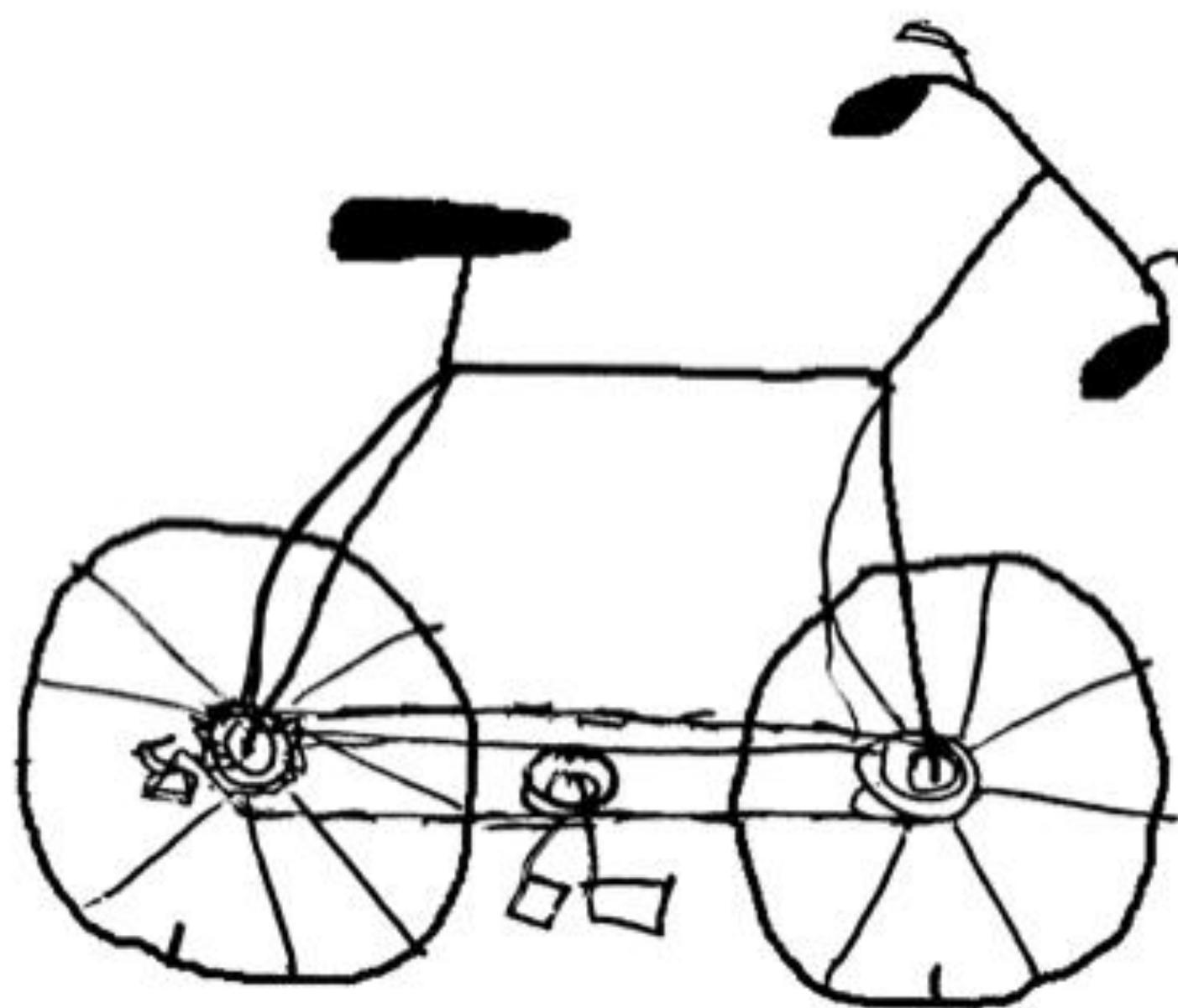
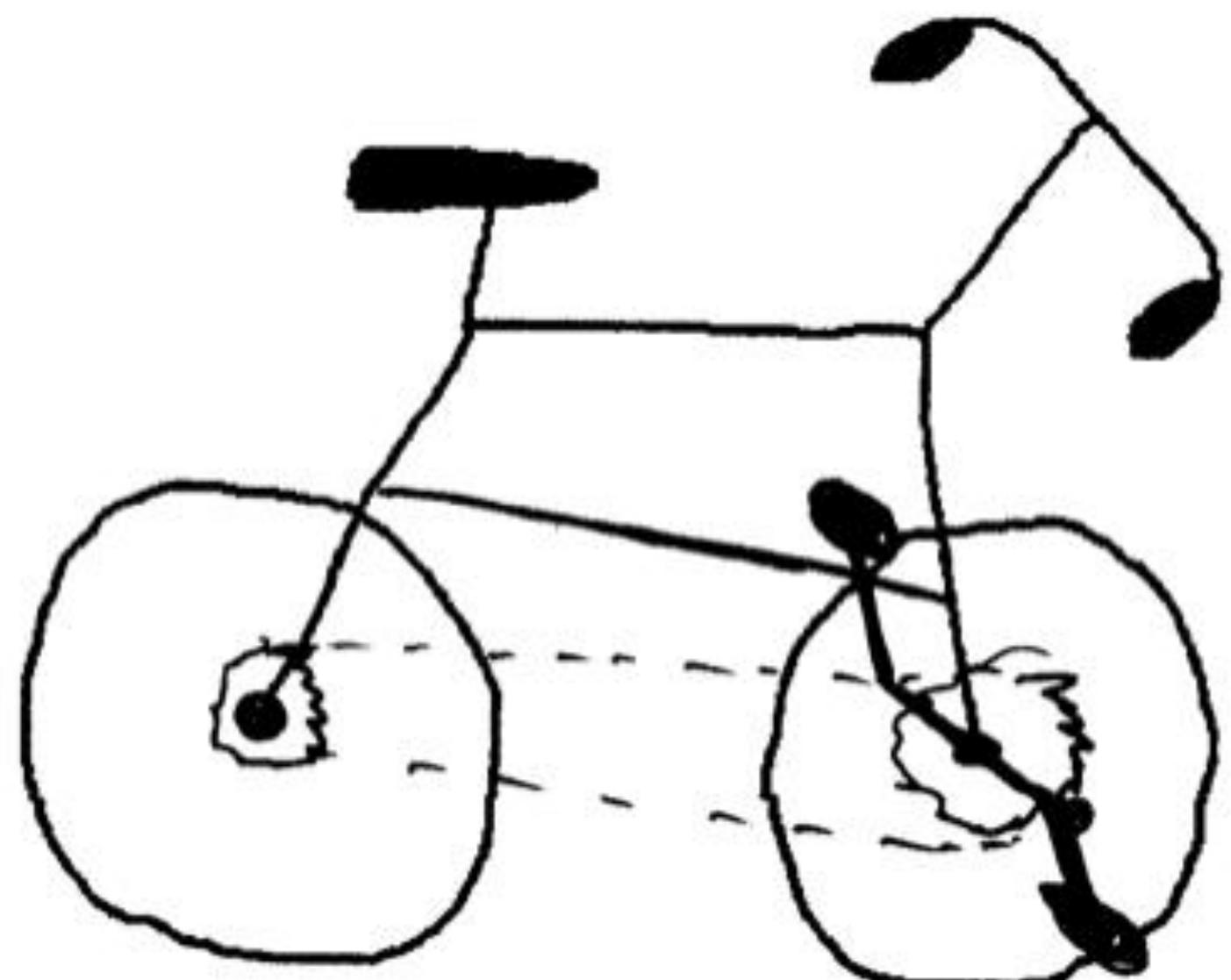
Pedals

Chain



https://www.liverpool.ac.uk/~rlawson/PDF_Files/L-M&C-2006.pdf

<https://road.cc/content/blog/90885-science-cycology-can-you-draw-bicycle>



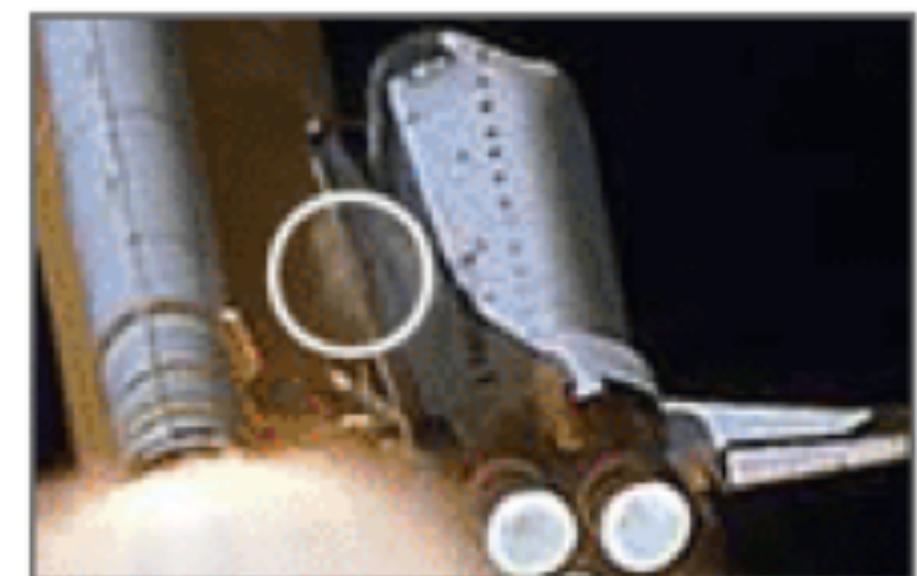
Overconfidence bias

- The tendency for decision makers to overestimate their own abilities
- Two types here:
 - Overplacement
 - Illusion of explanatory depth
- From wikipedia: an incomplete list of events related or triggered by bias/overconfidence and a failing (safety) culture:
 - Chernobyl disaster
 - Sinking of the Titanic
 - Space Shuttle Challenger disaster
 - Space Shuttle Columbia disaster
 - Deepwater Horizon oil spill
 - Titan submersible implosion



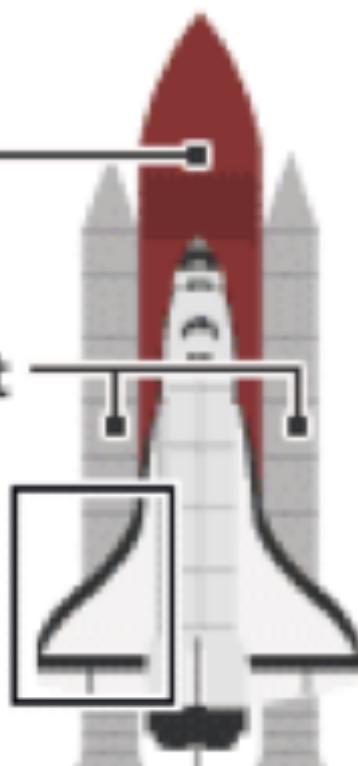
1. Launch: 16 Jan 2003

Foam from external tank strikes wing



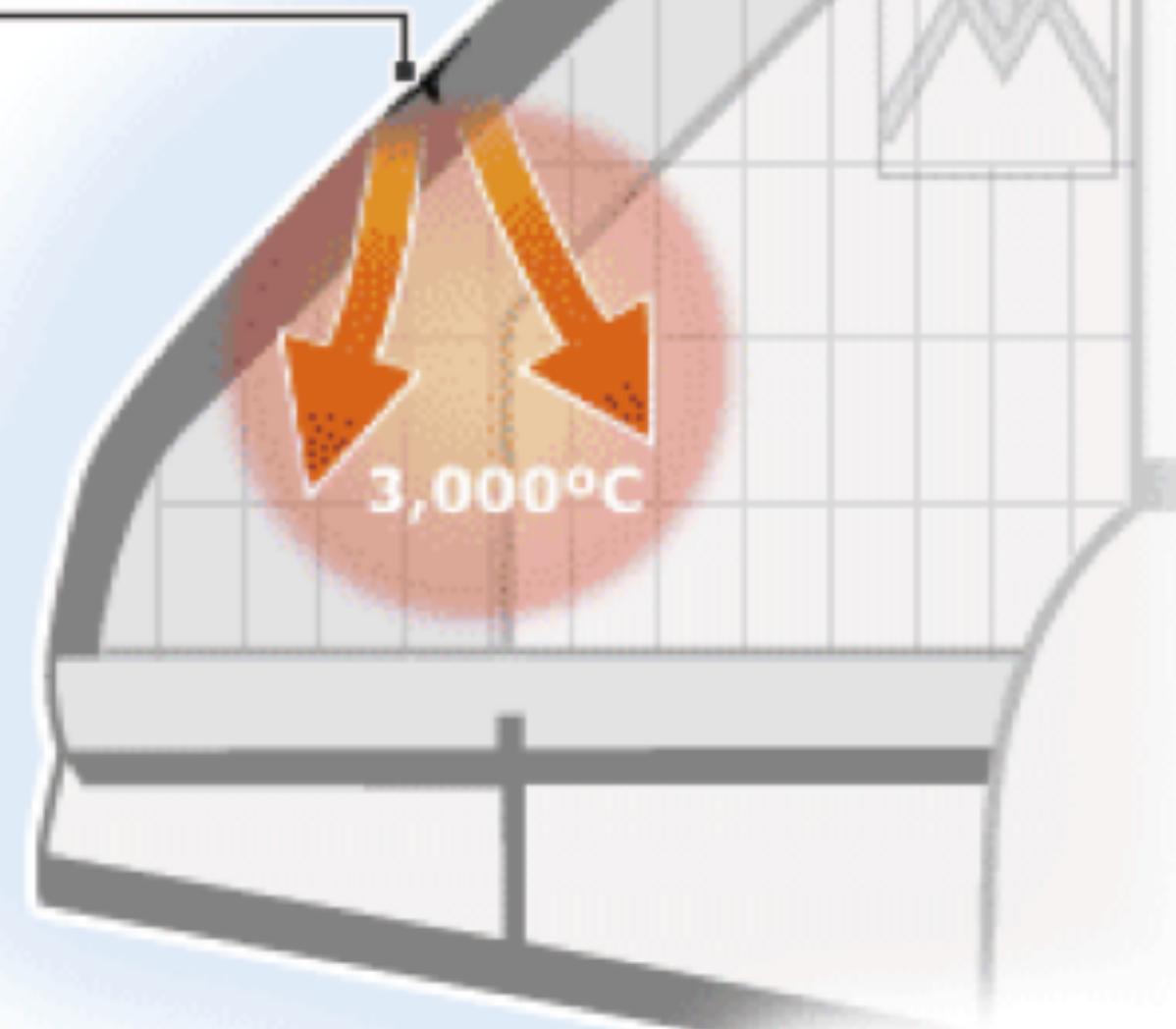
External
fuel tank

Solid rocket
boosters



2. Attempted re-entry: 1 February 2003

Crack in leading edge caused by impact allows superheated gas to penetrate. Wing interior melts and disintegrates



A list of names for exercise 3

- Travis Kelce
- Olivia Rodrigo
- Blake Lively
- Rock Hudson
- Selena Gomez
- Kesha
- Taylor Swift
- Charles Barkley
- Cardi B
- Bruno Mars
- David Seaman
- Richard Grieco
- Sinbad
- Steve Winwood
- Megan Thee Stallion
- Barry White
- Steven Tyler
- Beyonce
- Millie Bobby Brown
- Lady Gaga
- Robert Duvall

Exercise 3

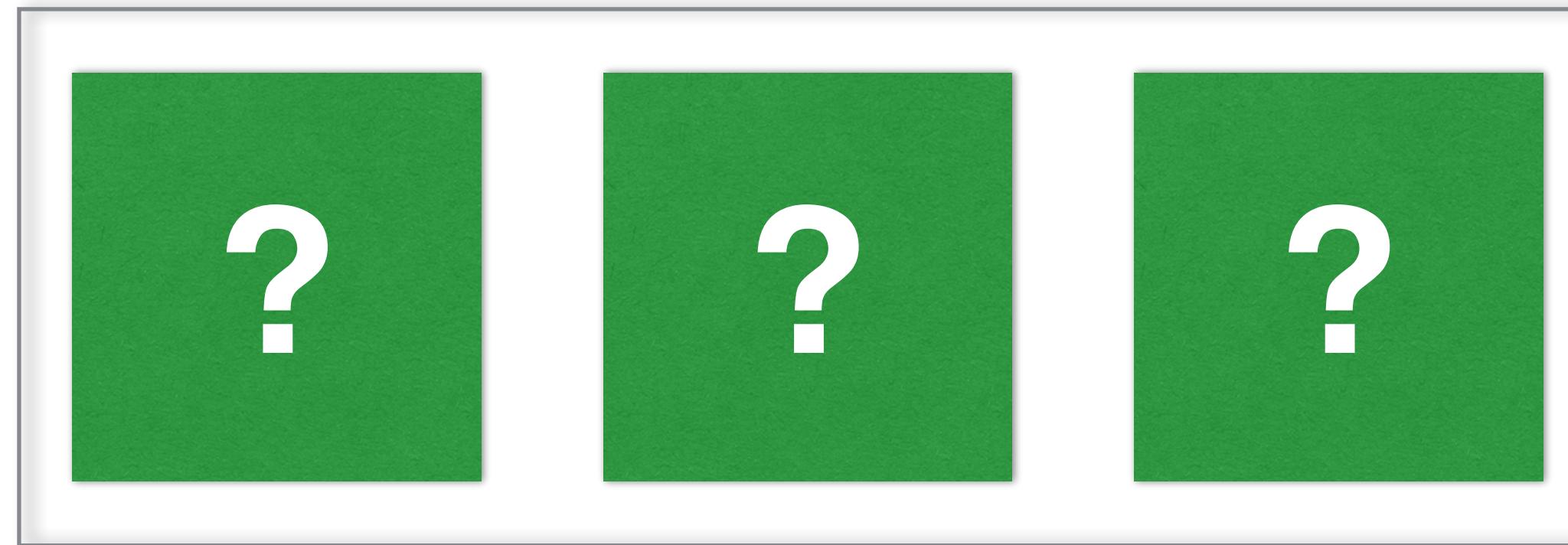
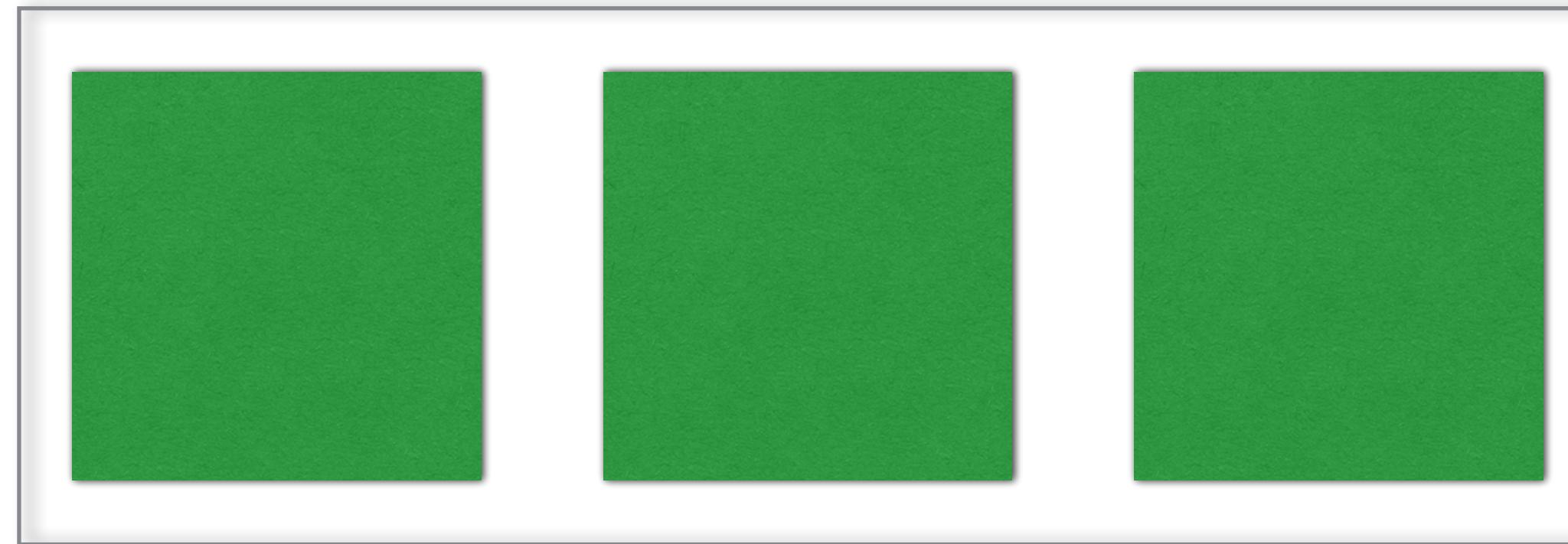


Availability bias

- The tendency for decision makers to consider information that is easily retrievable from memory as being more likely, more relevant, and more important for a judgment.
- What we saw
 - Recent celebrity names are easier to recognize/remember
 - More generally: memory is weird and wonky!

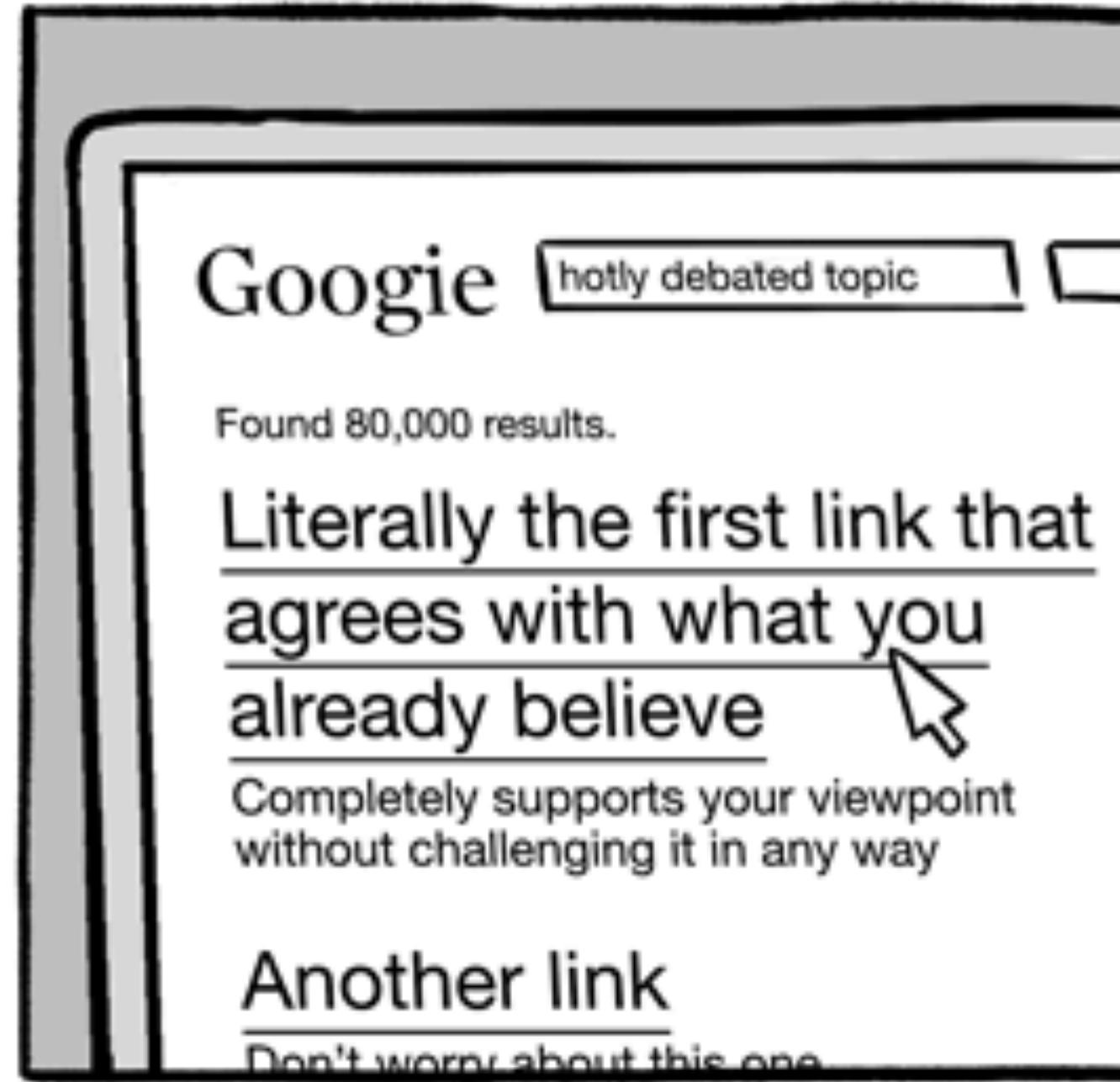
Exercise 4

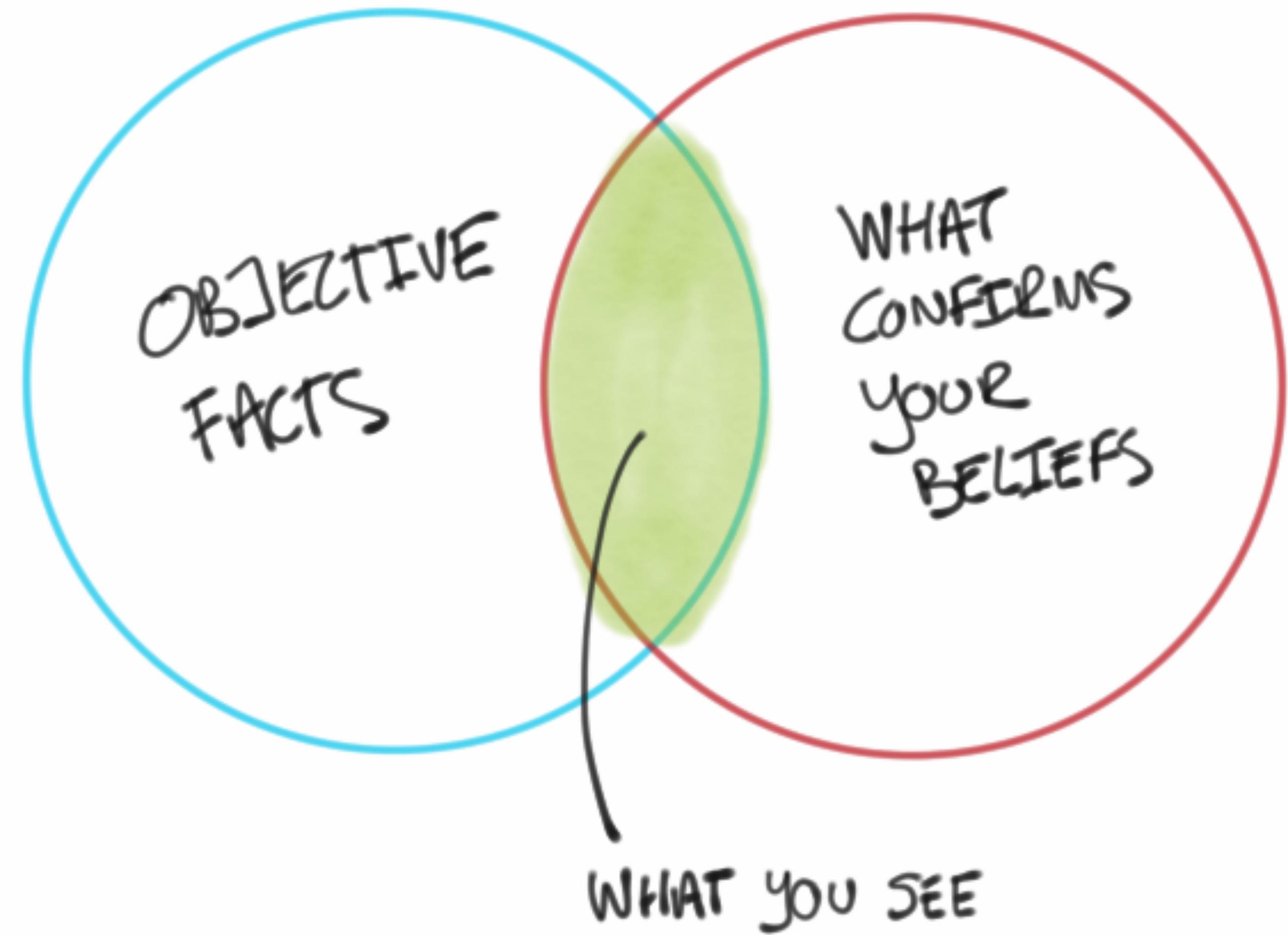
Figure out the rule



Confirmation bias

CHAINSAWSUIT.COM





Iran Air Flight 665 in 1988

Confirmation bias contributes to a major disaster

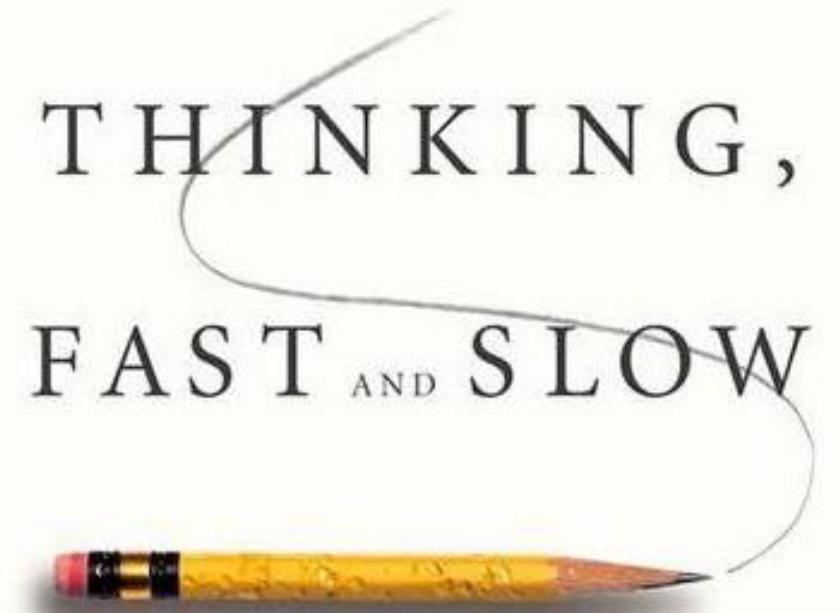
- Scheduled short hop commercial flight across the gulf
- Iran - Iraq war in active hostilities
- 1 year before Iranian airplane sunk USS Stark
- USS Vincennes had already engaged gunboats that day
- Radar saw airliner at takeoff. Thought it was an attack because a technical glitch briefly confused the ID of aircraft with that of an Iranian F-14
- Had 7 min from radar detection to launch of SAM, lots of time to figure it out, lots of evidence against it being an F-14
- 290 people killed

Thinking Fast and Slow

One origin of biases

- System 1
 - Fast, effortless, feels involuntary
- System 2
 - Slower, effort+attention, feels like agency
- Not real brain systems or regions!
- Evolutionary needs for both, biases and illusions are often adaptive
- Kahneman + Tversky

THE NEW YORK TIMES BESTSELLER



DANIEL
KAHNEMAN

WINNER OF THE NOBEL PRIZE IN ECONOMICS

"[A] masterpiece . . . This is one of the greatest and most engaging collections of insights into the human mind I have read." —WILLIAM EASTERLY, *Financial Times*

Fighting biases

- Instruction, feedback, and practice
 - Learn how to test your hypotheses
 - Develop the habit of questioning yourself and your ideas aggressively
- Justification of judgements, accountability
 - Procedures that force you into questioning the basis of the decision
 - Involving others if they are independent thinkers (beware groupthink!)

Errors of communication: Teamwork and comm failures

On this one Columbia slide, a PowerPoint festival of bureaucratic hyper-rationalism, 6 different levels of hierarchy are used to display, classify, and arrange 11 phrases:

- Level 1 Title of Slide
- Level 2 ● Very Big Bullet
- Level 3 — big dash
- Level 4 • medium-small diamond
- Level 5 • tiny square bullet
- Level 6 () parentheses ending level 5

The analysis begins with the dreaded Executive Summary, with a conclusion presented as a headline: "Test Data Indicates Conservatism for Tile Penetration." This turns out to be unmerited reassurance. Executives, at least those who don't want to get fooled, had better read far beyond the title.

The "conservatism" concerns the *choice of models* used to predict damage. But why, after 112 flights, are foam-debris models being calibrated during a crisis? How can "conservatism" be inferred from a loose comparison of a spreadsheet model and some thin data? Divergent evidence means divergent evidence, not inferential security. Claims of analytic "conservatism" should be viewed with skepticism by presentation consumers. Such claims are often a rhetorical tactic that substitutes verbal fudge factors for quantitative assessments.

As the bullet points march on, the seemingly reassuring headline fades away. Lower-level bullets at the end of the slide undermine the executive summary. This third-level point notes that "Flight condition [that is, the debris hit on the Columbia] is significantly outside of test database." How far outside? The final bullet will tell us.

This fourth-level bullet concluding the slide reports that the debris hitting the Columbia is estimated to be $1920/3 = 640$ times larger than data used in the tests of the model! The correct headline should be "Review of Test Data Indicates Irrelevance of Two Models." This is a powerful conclusion, indicating that pre-launch safety standards no longer hold. The original optimistic headline has been eviscerated by the lower-level bullets.

Note how close readings can help consumers of presentations evaluate the presenter's reasoning and credibility.

The Very-Big-Bullet phrase fragment does not seem to make sense. No other VBB's appear in the rest of the slide, so this VBB is not necessary.

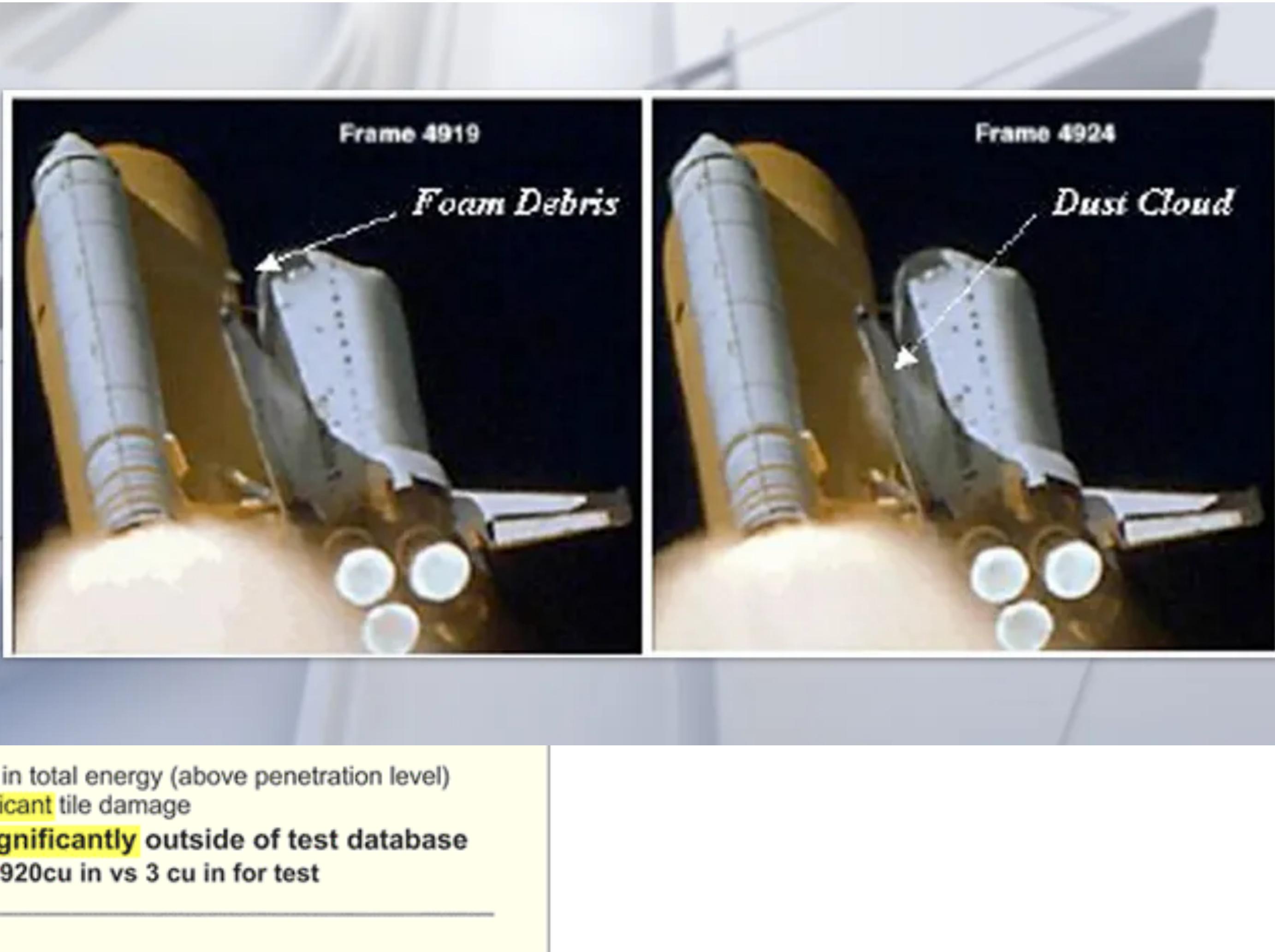
Spray On Foam Insulation, a fragment of which caused the hole in the wing

Review of Test Data I

- The existing SOFI on tile was reviewed along with the test data
- Crater overpredicted significantly
 - Initial penetration time
 - Varies with volume (3cu. In)
 - Significant energy required to penetrate the relatively soft tile
 - Test results do not match this requirement and velocity
 - Conversely, once the crater is formed, significant damage is not predicted
 - Minor variations in total energy (above penetration level) can cause significant tile damage
- Flight condition is significantly outside of test database
 - Volume of ramp is 1920cu in vs 3 cu in for test

BOEING

Here "ramp" refers to foam debris (from the bipod ramp) that hit Columbia. Instead of the cryptic "Volume of ramp," say "estimated volume of foam debris that hit the wing." Such clarifying phrases, which may help upper level executives understand what is going on, are too long to fit on low-resolution bullet outline formats. PP demands the shorthand of acronyms, phrase fragments, and clipped jargon in order to get at least some information into the tight format.



Edward Tufte

Our models are irrelevant

Debris hitting the wing was **640x** larger than the experimental data used to build these models

We have **no clue** what will happen on re-entry

Communication is key

Identify audience & setting

Identify key insight, main points of evidence, and assumptions

Organize into a story focussed on 

Create supporting visualizations

Revise to be as precise and concise as possible