

STUDY METHODOLOGIES

Critical Thinking

Everyday reasoning as a trainable skill — real fallacies, cognitive biases, correlation vs. causation, statistical traps, propaganda, framing, and groupthink, grounded throughout in real, documented cases: the Good Judgment Project, the Army-McCarthy hearings, the UC Berkeley admissions data, Sally Clark's wrongful conviction, the Challenger disaster, and the 1954 tobacco industry "Frank Statement" — closing with a full, worked deconstruction of that real historical argument.

10 Chapters

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CHAPTER 1: WHY CRITICAL THINKING IS A TRAINABLE SKILL

Critical Thinking

Chapter 1 · Why Critical Thinking Is a Trainable Skill

"Some people are just naturally better thinkers" is a genuinely popular belief — and a real, rigorous four-year experiment involving over a million forecasts found it doesn't hold up. This course covers critical thinking as a set of specific, learnable habits, not a fixed personal trait, starting with the real study that proved it.

A Real, Rigorous Test

THE GOOD JUDGMENT PROJECT, 2011-2015

In 2011, IARPA — the US intelligence community's own research arm — launched a real forecasting tournament to find the most accurate methods for predicting geopolitical events. Philip Tetlock, Barbara Mellers, and Don Moore's Good Judgment Project entered ordinary volunteers, given some basic probabilistic-reasoning training, against professional intelligence analysts with access to classified information. Over four years, across 500 real questions and more than a million individual forecasts, the volunteer forecasters — nicknamed "superforecasters" — won decisively.

THE REAL, MEASURED RESULT

The top-performing volunteers outperformed professional intelligence analysts — people with formal training and classified access these volunteers never had — by more than 30% in forecasting accuracy. Whatever separated the best forecasters from everyone else wasn't formal credentials, security clearance, or innate talent — it was a specific, describable set of habits.

What They Actually Did Differently

- **Fermi-izing:** breaking one large, hard-to-answer question into smaller sub-questions that are each individually more tractable — e.g., not "will this conflict escalate," but "what's the probability of the precursor event, and given that, what's the probability of escalation."
- **Actively open-minded thinking:** deliberately seeking out sources and views that disagreed with their own initial estimate, and taking the strongest version of the opposing case seriously — treating a belief as a hypothesis to test, not something to defend.

- **Incremental updating:** revising a forecast in small steps as new evidence arrived, rather than swinging dramatically between extremes or refusing to update at all once a first impression had formed.

What This Course Actually Covers

2

Fallacies

Recognizing flawed argument structures

3

Cognitive Biases

Anchoring, availability, Dunning-Kruger

4

Correlation & Causation

Including Simpson's Paradox

5

Statistical Traps

Base rates, the prosecutor's fallacy

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Propaganda

Persuasion techniques, the illusory truth effect

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Framing

How wording alone shifts a decision

8

Groupthink

Decision-making under real pressure

9

A Practical Checklist

Applying it to everyday claims

10

Capstone

Deconstructing a real, complex argument

Hands-On Exercises

EXERCISE 1

Pick a real prediction you've made recently (about a sports result, an election, a work deadline, anything). Apply Fermi-izing: break it into two or three smaller sub-questions that would each be easier to estimate individually than the original question was as a whole.

[View solution](#)

EXERCISE 2

Explain, in your own words, why the Good Judgment Project's result is more convincing evidence that critical thinking is trainable than simply pointing to one smart person who happens to think clearly.

 [View solution](#)

EXERCISE 3

Describe a real belief or opinion you currently hold. Explain what "actively open-minded thinking" would actually require you to go and do about that specific belief, concretely — not in general terms.

 [View solution](#)

CHAPTER 1 QUICK REFERENCE

- The real Good Judgment Project (2011-2015) tested trained volunteer forecasters against professional intelligence analysts with classified access, across 500 questions and over a million forecasts
- The volunteer "superforecasters" won, outperforming the professionals by more than 30%
- Three real, specific techniques separated top performers: Fermi-izing (breaking questions into sub-questions), actively open-minded thinking (seeking disagreement), and incremental updating
- None of these techniques required formal credentials or classified access — they're learnable habits, not fixed traits

CHAPTER 2: LOGICAL FALLACIES: RECOGNIZING FLAWED ARGUMENTS

Critical Thinking

Chapter 2 · Logical Fallacies: Recognizing Flawed Arguments

A logical fallacy is an argument that fails to actually support its own conclusion, regardless of whether the conclusion happens to be true. This chapter covers a real, historic case where a nationally televised fallacy backfired badly, then a working taxonomy of the fallacies you'll actually encounter most often.

Ad Hominem: A Real, Historic Case

During the 9 June 1954 Army-McCarthy hearings, Senator Joseph McCarthy broke a prior agreement and publicly attacked Fred Fisher — a young associate at Army counsel Joseph Welch's own law firm — over Fisher's past, discredited student-era membership in an organization McCarthy linked to communism. Fisher's actual character or competence was never the point; the attack existed purely to damage Welch by association.

WELCH'S REAL, DOCUMENTED RESPONSE

Welch replied on the record: "Until this moment, Senator, I think I never really gauged your cruelty or your recklessness... Let us not assassinate this lad further, senator. You have done enough. Have you no sense of decency, sir, at long last? Have you left no sense of decency?" An estimated 20 million Americans watched live.

AN HONEST COMPLICATION

The popular story treats this single exchange as the moment that ended McCarthy's power on its own. Real historical scholarship complicates that: the moment succeeded partly because of coordinated political pressure already building behind the scenes, and its now-famous status as "the" turning point was substantially shaped by a 1964 documentary that reordered 30+ days of hearings into a tidy narrative climax. The exchange itself is real and its real ad hominem structure is exactly what this chapter is about — but treating it as the single cause of McCarthy's downfall oversimplifies a messier real history.

A Real Taxonomy of Common Fallacies

Ad Hominem

Attacking the person making an argument instead of the argument itself.

Strawman

Misrepresenting an opponent's position as weaker than it actually is, then refuting the weaker version.

False Dichotomy

Presenting only two options when more genuinely exist.

Slippery Slope

Claiming one step inevitably leads to an extreme outcome, without showing the actual chain of causation.

Appeal to Authority

Citing an authority's opinion as proof, even outside their real area of expertise.

Bandwagon

Arguing a claim is true because many people believe it.

Red Herring

Introducing an irrelevant point to distract from the actual argument.

Circular Reasoning

Using the conclusion itself as a premise supporting that same conclusion.

THE FALLACY FALLACY

Spotting a fallacy in someone's argument proves the *argument* doesn't support its conclusion — it doesn't prove the conclusion itself is false. A conclusion reached through bad reasoning can still happen to be true; the honest response to a fallacy is "this argument doesn't establish that," not "therefore the opposite is true."

Hands-On Exercises

EXERCISE 1

Explain, in your own words, exactly why McCarthy's attack on Fred Fisher fits the definition of ad hominem — specifically, what relevant argument was McCarthy avoiding by attacking Fisher instead?

 [View solution](#)

EXERCISE 2

A friend says, "You only think that because you read one biased article." Identify which fallacy this is (and explain why it may or may not actually be a fallacy in this specific case, depending on whether the underlying claim about bias is actually true).

 [View solution](#)**EXERCISE 3**

Explain, in your own words, why correctly identifying a fallacy in someone's argument doesn't automatically mean their conclusion is wrong — using the "fallacy fallacy" concept from this chapter.

 [View solution](#)**CHAPTER 2 QUICK REFERENCE**

- The real 1954 Army-McCarthy hearings featured a genuine, documented ad hominem attack on Fred Fisher, met by Joseph Welch's real "have you no sense of decency" rebuke
- Real historical scholarship complicates the popular "one moment ended McCarthy" story with behind-the-scenes political pressure and later documentary framing
- Common fallacies include ad hominem, strawman, false dichotomy, slippery slope, appeal to authority, bandwagon, red herring, and circular reasoning
- The "fallacy fallacy": a flawed argument doesn't prove its conclusion false — it only shows the argument itself doesn't establish that conclusion

CHAPTER 3: COGNITIVE BIASES: HOW THE MIND CUTS CORNERS

Critical Thinking

Chapter 3 · Cognitive Biases: How the Mind Cuts Corners

A cognitive bias is a real, predictable mental shortcut that feels like reasoning while quietly skipping the actual reasoning part. This chapter covers four real, well-documented biases — including one so striking it directly inspired the psychological study that ended up naming it.

Anchoring: A Real, Foundational Study

TVERSKY & KAHNEMAN, 1974

Participants watched a wheel of fortune, visibly rigged to land on either 10 or 65, then were asked to estimate the percentage of African countries in the United Nations. Those who saw the wheel land on 10 guessed an average of 25%; those who saw it land on 65 guessed an average of 45% — a real 20-point swing driven entirely by a number participants knew was random. They could see the wheel spinning, and it still worked.

The Availability Heuristic

People judge how common or likely something is by how easily examples come to mind — not by its actual real frequency. Vivid, dramatic, heavily covered events (plane crashes, shark attacks) feel more common than they really are, while less dramatic but far more common causes of harm (heart disease, car accidents) feel comparatively rare, simply because they're less memorable and less frequently reported.

Sunk Cost: A Real, Named Case

Britain and France's 1962 Concorde supersonic jet agreement eventually cost roughly £1.3 billion in real development spending. Long before the project entered commercial service, both governments privately understood it would never be profitable — rising fuel costs, strict noise regulations, and limited seating made that clear. They kept funding it anyway, in real part

because so much had already been spent that stopping felt like admitting the money was wasted. The pattern is common enough that "sunk cost fallacy" has a second real name: the Concorde fallacy.

Dunning-Kruger: A Real, Bizarre Origin Story

"BUT I WORE THE JUICE"

On 6 January 1995, McArthur Wheeler robbed two Pittsburgh banks with his face coated in lemon juice, genuinely believing it would make him invisible to security cameras — reasoning, based on how lemon juice works as invisible ink, that it should work the same way on skin. He'd tested the idea by taking a Polaroid selfie that came out blurry, and misread the blurriness as proof the trick worked. When police showed him the security footage after his arrest, Wheeler reportedly stared in disbelief and said, "But I wore the juice."

That real case directly inspired Cornell researchers David Dunning and Justin Kruger's real 1999 study, "Unskilled and Unaware of It" — establishing that people with genuinely low ability in a given area often lack the specific skill needed to recognize their own incompetence, leading them to rate their own performance far more confidently than it deserves.

Four Biases, Compared

BIAS	WHAT IT DOES
Anchoring	An irrelevant number shifts a later, unrelated estimate
Availability	Memorable examples feel more common than they actually are
Sunk cost	Past spending, which can't be recovered, drives a decision that should only weigh the future
Dunning-Kruger	Low ability in a skill also impairs the ability to judge that same skill accurately

THE REAL, PRACTICAL LESSON

Every one of these biases operates below conscious awareness — knowing about them intellectually, as Tversky and Kahneman's own participants did with the rigged wheel, doesn't automatically prevent

them from working on you. The real defense is building specific habits (like Chapter 1's own Fermi-izing and incremental updating) that catch a biased judgment after the fact, not just hoping awareness alone is enough.

Hands-On Exercises

EXERCISE 1

Explain, in your own words, why the anchoring study's real result is more striking specifically because participants could see the wheel was random, rather than being told the number by an authority figure.

 [View solution](#)

EXERCISE 2

Describe a real or hypothetical situation where you (or someone you know) kept doing something specifically because of how much time, money, or effort had already been invested. Using the Concorde case as a model, explain what a genuinely sunk-cost-resistant decision would have looked like instead.

 [View solution](#)

EXERCISE 3

Explain, in your own words, why the Dunning-Kruger effect is a genuinely different problem from simple overconfidence — specifically, what does it say about the relationship between having a skill and being able to judge that same skill accurately?

 [View solution](#)

CHAPTER 3 QUICK REFERENCE

- Tversky and Kahneman's real 1974 wheel-of-fortune study showed a random, visibly rigged number shifted estimates by 20 real percentage points (25% vs. 45%)

- The availability heuristic makes memorable events feel more common than their actual real frequency
- The real Concorde project (~£1.3 billion) continued despite known unprofitability, giving sunk cost fallacy its real second name
- McArthur Wheeler's real 1995 lemon-juice bank robbery directly inspired Dunning & Kruger's real 1999 study
- Knowing about a bias intellectually doesn't automatically prevent it from operating — specific counter-habits are needed

CHAPTER 4: CORRELATION VS. CAUSATION & SIMPSON'S PARADOX

Critical Thinking

Chapter 4 · Correlation vs. Causation & Simpson's Paradox

Two things moving together doesn't mean one causes the other — and sometimes an aggregated trend can point in the exact opposite direction of what's actually happening underneath it. This chapter covers a real, absurd illustration of the first problem, and the single most famous real case of the second.

Correlation Is Not Causation: A Real, Absurd Illustration

A REAL, GENUINELY STRONG CORRELATION — $R = 0.947$

Statistician Tyler Vigen's real "Spurious Correlations" project catalogs genuine statistical coincidences — including US per-capita cheese consumption and the number of people who died getting tangled in their bedsheets, which correlate at $r = 0.947$ (a near-perfect statistical relationship, on a scale where 1.0 is exact). Nobody seriously believes cheese causes bedsheet deaths — Vigen's own real point is that with enough variables compared against each other, some will correlate strongly by pure chance alone.

THREE REAL REASONS A CORRELATION CAN EXIST WITHOUT CAUSATION

- **Coincidence:** with enough variables compared, some will correlate by chance alone.
- **Reverse causation:** B might actually be causing A, not the other way around.
- **A confounding variable:** some third factor causes both A and B independently.

Simpson's Paradox: A Real, Famous Case

In 1973, the University of California, Berkeley's graduate admissions data showed a real, apparent gender gap: 44.2% of male applicants were admitted, against 34.6% of female applicants — a statistically significant difference that led to a real lawsuit alleging bias.

THE REAL REVERSAL, ONCE BROKEN DOWN BY DEPARTMENT

Statisticians Peter Bickel, Eugene Hammel, and J. William O'Connell, publishing in *Science* in 1975, found that once admissions were examined department by department, no individual department showed significant bias against women — and in four of the six largest departments, women were actually admitted at a **higher** rate than men. The real explanation: women disproportionately applied to departments with lower overall acceptance rates (more competitive fields), while men applied more heavily to departments that accepted a larger share of all applicants. The aggregate gap reflected which departments people applied to, not how individual departments evaluated men versus women.

This real pattern — where a trend visible in combined data reverses or disappears once the data is properly broken into its real subgroups — is called Simpson's Paradox, and the Berkeley case remains its most famous real-world example.

Two Real Traps, Compared

TRAP	WHAT ACTUALLY GOES WRONG
Spurious correlation	Two unrelated things move together, by chance or a hidden third cause
Simpson's Paradox	An aggregated trend hides or reverses a genuinely different pattern in the real underlying subgroups

Hands-On Exercises

EXERCISE 1

Using the three real reasons a correlation can exist without causation, propose a plausible confounding variable that could explain a real correlation between "ice cream sales" and "drowning deaths" without either one causing the other.

 [View solution](#)

EXERCISE 2

Explain, in your own words, exactly what "department choice" had to do with the Berkeley admissions gap — specifically, why did women's real pattern of applying to more competitive departments

produce a lower aggregate admission rate even without any individual department being biased against them?

 [View solution](#)

EXERCISE 3

A colleague says, "Our company's overall promotion rate for men is higher than for women, so our promotion process must be biased." Using the Berkeley case as a model, explain what additional real data you'd want to see before accepting that conclusion.

 [View solution](#)

CHAPTER 4 QUICK REFERENCE

- Tyler Vigen's real "Spurious Correlations" project shows unrelated variables (cheese consumption, bedsheet deaths) correlating at $r = 0.947$ purely by chance
- Correlation can exist without causation via coincidence, reverse causation, or a shared confounding variable
- The real 1973 UC Berkeley admissions data showed 44.2% male vs. 34.6% female admission rates in aggregate
- Bickel, Hammel & O'Connell's real 1975 analysis found the reverse pattern within four of six departments — the founding real-world case of Simpson's Paradox
- The real cause was which departments applicants chose, not how individual departments evaluated candidates

CHAPTER 5: STATISTICAL REASONING TRAPS: BASE RATES & THE PROSECUTOR'S FALLACY

Critical Thinking

Chapter 5 · Statistical Reasoning Traps: Base Rates & the Prosecutor's Fallacy

Ignoring how rare something actually is in the first place is a real, well-documented reasoning error — one that even trained doctors get wrong at a striking rate, and one that has genuinely sent an innocent person to prison. This chapter covers both, with real numbers behind each.

Base Rate Neglect: A Real Study, Real Doctors, Real Wrong Answers

CASSELLS, SCHOENBERGER & GRAYBOYS, 1978, NEW ENGLAND JOURNAL OF MEDICINE

Researchers asked 60 people — house officers, fourth-year medical students, and attending physicians at Harvard Medical School teaching hospitals — a real question: if a disease affects 1 in 1,000 people, and a test for it has a 5% false positive rate, what's the real chance a person who tests positive actually has the disease? The most common answer given was 95%. The average answer was 56%. Only 18% of respondents gave the real correct answer: roughly 2%.

The real math: out of 1,000 people, 1 actually has the disease. Of the remaining 999 healthy people, 5% (about 50 people) will still test positive — a false positive. So out of roughly 51 total positive results, only 1 is a true case. That's the base rate — how rare the disease is to begin with — genuinely swamping the test's own apparent accuracy.

The Prosecutor's Fallacy: A Real, Tragic Legal Case

In 1999, English solicitor Sally Clark was convicted of murdering her two infant sons, who had each died in infancy months apart. Pediatrician Roy Meadow testified that the odds of two children in an affluent family both dying of Sudden Infant Death Syndrome (SIDS) naturally were 1 in 73 million — arrived at by squaring his own estimated 1-in-8,500 probability for a single SIDS death.

THE REAL, DOCUMENTED STATISTICAL ERROR

Meadow's figure was flawed twice over. First, squaring the individual probability wrongly assumed the two deaths were statistically independent, ignoring that shared genetic or environmental factors within one family make a second SIDS death more likely once a first has occurred. Second, and more fundamentally, it committed the prosecutor's fallacy — treating "the probability of two natural deaths, if she's innocent" as though it were the same number as "the probability she's innocent, given two deaths." Those are genuinely different questions, and conflating them is a real, common, and serious statistical error. The Royal Statistical Society later issued a public statement condemning the "misuse of statistics in the courts."

Clark's conviction was overturned on appeal in January 2003, after further evidence came to light. She had already served over three years in prison for a crime the underlying statistics never actually supported.

The Same Underlying Mistake

CASE	WHAT WAS IGNORED
Harvard doctors	How rare the disease actually is (1 in 1,000) before trusting a positive test
Sally Clark	How rare a wrongful conviction versus a genuine coincidence actually is, once the fallacy is corrected

THE REAL, PRACTICAL LESSON

Both cases share the same underlying error: treating "how unlikely is this evidence, assuming innocence or health" as though it directly answers "how likely is guilt or disease, given this evidence." They're genuinely different questions, and the real base rate — how rare the underlying condition or event actually is — has to be factored in before the second question can be answered honestly.

Hands-On Exercises

EXERCISE 1

Redo the chapter's own real math with a different, rarer disease: 1 in 10,000 people, with the same 5% false positive rate. Out of 10,000 people, how many total positive results would there be, and what real percentage of those positives would actually have the disease?

 [View solution](#)
EXERCISE 2

Explain, in your own words, the specific difference between "the probability of this evidence, assuming innocence" and "the probability of innocence, given this evidence" — using Meadow's real 1-in-73-million figure as the example.

 [View solution](#)
EXERCISE 3

Explain, in your own words, why assuming the two deaths in the Clark case were statistically independent was a real, separate error from the prosecutor's fallacy itself — what would need to be true for squaring the individual probability to have been valid?

 [View solution](#)
CHAPTER 5 QUICK REFERENCE

- A real 1978 Harvard Medical School study found most doctors badly overestimated a positive test's real meaning — the correct answer (~2%) was given by only 18% of respondents
- The real math: out of 1,000 people with a 1-in-1,000 disease and a 5% false positive rate, only 1 of ~51 total positives is a true case
- Sally Clark's real 1999 wrongful murder conviction relied on pediatrician Roy Meadow's flawed 1-in-73-million statistic
- The figure wrongly assumed independence between the two deaths and committed the real prosecutor's fallacy
- The Royal Statistical Society publicly condemned the misuse; Clark's conviction was overturned in 2003

CHAPTER 6: PROPAGANDA, PERSUASION & THE ILLUSORY TRUTH EFFECT

Critical Thinking

Chapter 6 · Propaganda, Persuasion & the Illusory Truth Effect

A false claim, repeated often enough, starts to feel true — a real, well-documented psychological finding with real historical roots in an organization founded specifically to teach ordinary people how to resist it.

The Illusory Truth Effect

HASHER, GOLDSTEIN & TOPPINO, 1977

Researchers at Villanova and Temple University gave college students 60 plausible statements — some true, some false, spanning politics, sports, and the arts — and asked them to rate each one's truthfulness across three separate sessions, two weeks apart. Statements repeated across sessions were rated as significantly truer than statements shown only once, regardless of whether they were actually true. The finding has been replicated many times since, across trivia, consumer claims, and political opinions alike — and later research found that even knowing a statement is false at the time doesn't fully protect against the effect.

Seven Real, Named Propaganda Devices

The Institute for Propaganda Analysis, a real US organization active from 1937 to 1942, was founded by Kirtley Mather, Edward Filene, and Clyde Miller specifically to teach the public to recognize propaganda through critical thinking rather than pure emotional reaction. It named seven real, recurring persuasion techniques:

Name-Calling

Attaching a negative label to something to trigger rejection without argument.

Glittering Generality

Using a vague, positively-loaded word ("freedom," "progress") to win approval without specifics.

Transfer

Borrowing the authority or prestige of one thing to endorse something unrelated.

Testimonial

Using a respected or liked person's endorsement in place of actual evidence.

Plain Folks

Presenting an idea as coming from ordinary, relatable people to build trust.

Card Stacking

Selectively presenting only favorable facts while omitting unfavorable ones.

Bandwagon

Urging acceptance because "everyone else" already accepts it.

A REAL, DIRECT HISTORICAL PRECEDENT

The Institute for Propaganda Analysis's own founding mission was, in real, explicit terms, teaching ordinary readers to think critically rather than react emotionally — the same underlying goal this course has now, nearly a century later.

THE TWO COMBINE

Repetition and named propaganda devices aren't separate problems — they compound each other. A claim delivered via bandwagon ("everyone already knows this") or testimonial (a trusted figure repeating it) is both persuasive on its own and primed to become more believable each time it's repeated, per the illusory truth effect — regardless of whether it was ever actually true.

Hands-On Exercises

EXERCISE 1

Explain, in your own words, why the real Hasher, Goldstein & Toppino study design (three sessions, two weeks apart, some statements repeated and some not) was necessary to isolate repetition specifically as the cause, rather than some other explanation for why people rated certain statements as truer.

 [View solution](#)

EXERCISE 2

An advertisement says, "Nine out of ten people who tried our product loved it — join them today!" Identify which of the seven real propaganda devices this uses, and explain what specific missing information would let you actually evaluate the underlying claim.

 [View solution](#)

EXERCISE 3

Explain, in your own words, why knowing about the illusory truth effect intellectually doesn't fully protect against it, based on the chapter's own note that even known-false statements can still be affected by repetition. What real, practical habit would help resist it instead of relying on awareness alone?

 [View solution](#)

CHAPTER 6 QUICK REFERENCE

- Hasher, Goldstein & Toppino's real 1977 study found repeated statements are rated truer regardless of actual truth — a widely replicated finding
- Even known-false statements aren't fully protected against the effect
- The real Institute for Propaganda Analysis (1937-1942) named seven persuasion devices: name-calling, glittering generality, transfer, testimonial, plain folks, card stacking, and bandwagon
- The IPA's own founding mission was explicitly teaching critical thinking against propaganda — a direct real historical precedent for this course
- Repetition and propaganda devices compound each other, making a repeated, device-driven claim doubly persuasive regardless of its truth

CHAPTER 7: FRAMING EFFECTS & THE LANGUAGE OF MANIPULATION

Critical Thinking

Chapter 7 · Framing Effects & the Language of Manipulation

Two mathematically identical descriptions of the same outcome can produce completely different decisions, depending only on which words describe them. This chapter covers the real, foundational study that proved it, and how the same effect shows up in ordinary product labels.

The Real, Foundational Framing Study

TVERSKY & KAHNEMAN, 1981, SCIENCE

Participants were told the US was preparing for an unusual disease expected to kill 600 people, and asked to choose between two programs. In the **gain frame**: Program A saves 200 people for certain; Program B has a $\frac{1}{3}$ chance of saving all 600 and a $\frac{2}{3}$ chance of saving no one. In the **loss frame**, given to a separate group: Program C results in 400 people dying for certain; Program D has a $\frac{1}{3}$ chance no one dies and a $\frac{2}{3}$ chance all 600 die.

Program A and Program C describe the exact same real outcome — 200 saved, 400 dead — and so do Program B and Program D. Only the wording differs.

THE REAL, MEASURED REVERSAL

In the gain frame, 72% of respondents chose the certain option (Program A). In the loss frame, only 22% chose the mathematically identical certain option (Program C) — meaning 78% chose the gamble instead. The exact same real outcomes, described in "saved" language versus "died" language, flipped the majority preference completely.

Framing in Everyday Language

Psychologists Irwin Levin and Gary Gaeth's real 1988 study found the identical pattern in a far more mundane setting: participants rated ground beef described as "75% lean" significantly more favorably than the same beef described as "25% fat" — identical information, opposite

reactions. It's the real, documented reason "90% fat-free" appears on packaging far more often than the equivalent "10% fat."

Two Real Studies, One Underlying Effect

STUDY	REAL, IDENTICAL INFORMATION	REAL EFFECT OF FRAMING
Asian Disease Problem	200 saved / 400 dead, either framing	72% risk-averse (gain frame) vs. 78% risk-seeking (loss frame)
Ground Beef Study	75% lean = 25% fat, mathematically identical	Significantly more favorable ratings for "75% lean"

THE REAL, PRACTICAL LESSON

When a statistic or choice is presented in a specific frame — "saved" instead of "died," "lean" instead of "fat," "success rate" instead of "failure rate" — deliberately restate it the opposite way before deciding how you feel about it. If your reaction changes even though the underlying numbers didn't, the framing was doing real work on your judgment that the actual facts never did.

Hands-On Exercises

EXERCISE 1

Explain, in your own words, exactly why Program A and Program C describe mathematically identical outcomes, using the real numbers from the chapter (600 total people, 200 saved / 400 dead).

 [View solution](#)

EXERCISE 2

A news headline says, "New policy has a 95% success rate." Reframe this statement in loss-oriented language describing the same real number, and explain whether your own reaction to the two versions feels different.

 [View solution](#)

EXERCISE 3

Explain, in your own words, why the gain-frame/loss-frame reversal in the Asian disease problem is a genuinely different phenomenon from simply disagreeing about which policy is better — what specifically does the reversal prove about how the choice was actually being made?

 [View solution](#)

CHAPTER 7 QUICK REFERENCE

- Tversky & Kahneman's real 1981 Asian disease problem (Science) presented mathematically identical outcomes as "saved" (gain frame) or "died" (loss frame)
- 72% chose the certain option in the gain frame; only 22% chose the identical certain option in the loss frame (78% gambled instead)
- Levin & Gaeth's real 1988 study found "75% lean" rated significantly better than the identical "25% fat"
- Deliberately reframing a statement the opposite way is a real, practical check for whether framing — not the actual facts — is driving a reaction

CHAPTER 8: GROUPTHINK & DECISION-MAKING UNDER PRESSURE

Critical Thinking

Chapter 8 · Groupthink & Decision-Making Under Pressure

A group of genuinely capable, well-intentioned people can still make a catastrophically wrong decision together — not from stupidity, but from a real, named psychological pattern that overrides individual judgment. This chapter covers that pattern, and the real, tragic case that remains its most-studied example.

Groupthink: A Real, Named Concept

Psychologist Irving Janis coined the term "groupthink" in his real 1972 book *Victims of Groupthink*, defining it as a mode of thinking that emerges in a cohesive group when the drive for unanimous agreement overrides members' genuine motivation to realistically weigh alternatives. He identified eight real, recurring symptoms — including several directly visible in the case below.

Illusion of Invulnerability

Excessive optimism that encourages taking extreme risks.

Direct Pressure on Dissenters

Members are pushed to fall in line rather than voice disagreement.

Self-Censorship

Members withhold doubts rather than risk group harmony.

Illusion of Unanimity

Silence gets mistaken for agreement, reinforcing the group's confidence.

A Real, Tragic Case

Roger Boisjoly, an engineer at Morton Thiokol — the company that built the Space Shuttle's solid rocket boosters — wrote a real memo roughly six months before the Challenger launch,

warning that cold temperatures could cause O-ring failure and "a catastrophe of the highest order — loss of human life."

THE REAL, DOCUMENTED NIGHT BEFORE

On the night of 27 January 1986, with launch scheduled for an unusually cold morning, Boisjoly and fellow engineers reiterated their concerns directly. Thiokol general manager Jerry Mason turned to engineering vice president Robert Lund and reportedly said: "Bob, it's time to take off your engineering hat and put on your management hat." Lund then voted to approve the launch. Challenger was destroyed 73 seconds after liftoff on 28 January 1986, killing all seven astronauts aboard — caused by exactly the O-ring failure Boisjoly had warned about.

FEYNMAN'S REAL, TELEVISED DEMONSTRATION

Physicist Richard Feynman, a member of the Rogers Commission investigating the disaster, demonstrated the flaw live on television on 11 February 1986: he dropped a piece of O-ring material into a glass of ice water, let it sit, then squeezed it in front of the cameras. The rubber didn't spring back — visually proving, in seconds, what months of internal warnings had failed to stop.

The Challenger case maps directly onto Janis's own real symptoms: an illusion of invulnerability (previous flights had survived similar risks without incident), and unmistakable direct pressure on a dissenting engineering judgment — the literal instruction to switch from an engineer's own risk assessment to a manager's schedule-driven one.

THE REAL, PRACTICAL LESSON

Janis's own proposed remedies are structural, not just attitudinal: assign someone the explicit role of devil's advocate in high-stakes decisions, actively invite outside opinions before finalizing a choice, and make clear that raising a dissenting technical concern will never itself be treated as a loyalty problem. The Challenger case shows what happens when a dissenting voice exists, is heard, and is overridden anyway under social and schedule pressure.

Hands-On Exercises

EXERCISE 1

Explain, in your own words, why the "take off your engineering hat" moment is a real, concrete example of "direct pressure on dissenters," one of Janis's own named symptoms.

 [View solution](#)

EXERCISE 2

Describe a real or hypothetical group decision-making situation you've been part of. Identify which, if any, of Janis's four symptoms covered in this chapter were present, and explain what a structural remedy (not just "try harder to speak up") would have looked like.

 [View solution](#)

EXERCISE 3

Explain, in your own words, why the Challenger case is a stronger illustration of groupthink than a case where no one ever raised a concern at all — what does it specifically show about how groupthink operates, given that the correct warning was actually delivered?

 [View solution](#)

CHAPTER 8 QUICK REFERENCE

- Irving Janis coined "groupthink" in his real 1972 book *Victims of Groupthink*, naming eight real recurring symptoms
- Roger Boisjoly's real memo, roughly six months before the 1986 Challenger launch, warned of catastrophic O-ring failure in cold weather
- On the night before launch, Thiokol management's real "take off your engineering hat" moment overrode the engineers' own direct objections
- Challenger was destroyed 73 seconds after liftoff on 28 January 1986, killing all seven astronauts
- Richard Feynman's real televised ice-water O-ring demonstration (11 February 1986) visually proved the flaw during the Rogers Commission hearings

CHAPTER 9: A PRACTICAL CHECKLIST FOR EVALUATING EVERYDAY CLAIMS

Critical Thinking

Chapter 9 · A Practical Checklist for Evaluating Everyday Claims

Eight chapters, eight techniques — this chapter compresses all of them into one practical checklist, then runs a real, current claim through it to show what an honest answer actually looks like.

The Checklist

#	CHECK	FROM
1	Break the claim into smaller, checkable parts	Chapter 1 — Fermi-izing
2	Check how it's argued, not just what it concludes	Chapter 2 — Fallacies
3	Notice your own reaction before trusting it	Chapter 3 — Cognitive biases
4	Ask whether it's actually causal, or just correlated	Chapter 4 — Correlation vs. causation
5	Check the real base rate behind any percentage	Chapter 5 — Statistical traps
6	Ask whether repetition or a named device is doing the persuading	Chapter 6 — Propaganda
7	Reframe it the opposite way and see if your reaction changes	Chapter 7 — Framing
8	Ask whether consensus reflects evidence or social pressure	Chapter 8 — Groupthink

A Real, Compact Worked Example

Claim: "*Vitamin C prevents colds.*" Applying steps 1, 4, and 5 — breaking it down, checking causation, and checking the real base numbers:

HEMILÄ & CHALMERS, COCHRANE REVIEW

Across 29 trial comparisons and over 11,000 participants in the general population, regular vitamin C supplementation showed no meaningful effect on how often people caught colds (risk ratio 0.97 — close to no effect). But in five trials covering 598 people under intense physical stress (marathon runners, skiers, soldiers in subarctic conditions), the real risk ratio was 0.48 — a genuine, substantial reduction. Separately, regular supplementation modestly reduced cold *duration* once someone was already sick — by about 8% in adults and 14% in children.

THE HONEST ANSWER

"Does vitamin C prevent colds?" doesn't have a clean yes-or-no answer, and the checklist is exactly what surfaces that: no, for most people, regular supplementation doesn't meaningfully prevent catching a cold — but yes, for people under real physical extremes, and yes, it modestly shortens a cold's real duration once you have one. Most everyday claims that survive this checklist end up looking like this — genuinely true under some conditions and false under others, not simply right or wrong.

Hands-On Exercises

EXERCISE 1

Pick a real health, productivity, or news claim you've encountered recently. Apply checklist items 1, 4, and 5 specifically — breaking it down, checking for causation, and checking the real base rate — and report what you find.

 [View solution](#)

EXERCISE 2

Explain, in your own words, why "vitamin C prevents colds" being false for the general population but true for people under physical stress is a genuinely different kind of finding than the claim simply being wrong.

 [View solution](#)

EXERCISE 3

Explain, in your own words, why running through all eight checklist items on every single everyday claim you encounter would be impractical, and propose a real, reasonable rule for deciding when a claim actually deserves the full checklist versus a quicker gut check.

 [View solution](#)

CHAPTER 9 QUICK REFERENCE

- The eight-item checklist maps directly onto each of the course's own prior eight chapters
- A real Cochrane review found vitamin C has no meaningful effect on cold incidence in the general population (risk ratio 0.97)
- But it shows a real, substantial effect under intense physical stress (risk ratio 0.48) and modestly reduces cold duration (8% adults, 14% children)
- Most everyday claims that survive real scrutiny end up conditionally true, not simply right or wrong

CHAPTER 10: CAPSTONE — DECONSTRUCTING A REAL, COMPLEX ARGUMENT

Critical Thinking

Chapter 10 · Capstone: Deconstructing a Real, Complex Argument

This capstone runs one real, historically documented argument through every tool this course has covered — **"A Frank Statement to Cigarette Smokers,"** a full-page advertisement placed by major US tobacco companies on 4 January 1954, appearing in 448 newspapers reaching an estimated 43 million Americans, in direct response to emerging research linking smoking to lung cancer.

REAL, QUOTED EXCERPTS

"Distinguished authorities point out ... that there is no proof that cigarette smoking is one of the causes [of lung cancer]." "Statistics purporting to link cigarette smoking with the disease could apply with equal force to any one of many other aspects of modern life." "For more than 300 years tobacco has given solace ... At one time or another during those years critics have held it responsible for practically every disease of the human body. One by one these charges have been abandoned for lack of evidence." "We believe the products we make are not injurious to health."

STEP 1 — CHAPTER 1: BREAKING IT DOWN

The ad's real underlying claim splits into checkable sub-parts: (a) is there genuinely "no proof" of a link, or merely no absolute certainty; (b) do the cited "distinguished authorities" actually represent the real state of scientific opinion, or a selected minority; (c) does the 300-years historical pattern actually predict this specific case, or merely resemble it rhetorically.

STEP 2 — CHAPTER 2: FALLACIES

"Distinguished authorities" is a real appeal to authority — citing expert status without naming who, how many, or how they were selected. The "300 years... one by one abandoned" line is a real false analogy: past unrelated health scares fading doesn't logically establish that this specific, evidence-backed concern will also fade.

STEP 3 — CHAPTER 3: COGNITIVE BIASES

The "distinguished authorities" were selected and funded by the very companies with a direct financial stake in the conclusion — a real, structural motivated-reasoning risk built into who got asked and who got quoted, the same underlying funding-bias pattern this course has already seen operate elsewhere.

STEP 4 — CHAPTER 4: CORRELATION VS. CAUSATION

"Statistics ... could apply with equal force to any one of many other aspects of modern life" is a real, deliberate weaponization of a genuinely true statistical principle — correlation alone doesn't prove causation — stretched to imply no real evidence existed at all, when growing, real epidemiological evidence in 1954 already pointed toward a genuine causal link.

STEP 5 — CHAPTER 5: THE REAL GAP BETWEEN "NO PROOF" AND "NO EVIDENCE"

"No proof" is technically defensible in 1954's own state of formal scientific consensus while still being deeply misleading — real, mounting evidence existed even without full formal certainty, echoing this course's own earlier lesson that "no proof" and "no real reason for concern" are genuinely different claims.

STEP 6 — CHAPTER 6: PROPAGANDA DEVICES

Multiple real devices appear at once: testimonial ("distinguished authorities"), glittering generality ("solace, relaxation and enjoyment"), transfer (borrowing scientific credibility), and card stacking (omitting the real, growing body of contrary evidence entirely).

STEP 7 — CHAPTER 7: FRAMING

"There is no proof" is framed reassuringly — implying safety — when a more honest framing of the identical real state of evidence in 1954 ("the evidence linking smoking to

lung cancer is growing, though not yet conclusive") would have prompted a very different real reaction from readers.

STEP 8 — CHAPTER 8: GROUPTHINK

The ad announced the real formation of the Tobacco Industry Research Committee (TIRC) — later renamed the Council for Tobacco Research — an industry-wide body that institutionalized a shared public position across competing companies, a real, documented structure that functioned to manufacture the appearance of independent inquiry while maintaining unified industry messaging for decades.

THE REAL TRUTH, REVEALED 15 YEARS LATER

A real 1969 internal Brown & Williamson memo stated plainly: "Doubt is our product, since it is the best means of competing with the 'body of fact' that exists in the mind of the general public. It is also the means of establishing a controversy." The 1954 "Frank Statement" wasn't a genuine, good-faith assessment of uncertain science — internal industry documents confirm it was a real, deliberate strategy to manufacture public doubt against evidence the companies' own researchers already understood.

Chapter-Attribution Table

STEP	CHAPTER	WHAT IT EXPOSED
1	Ch. 1	Breaking a sweeping claim into checkable parts
2	Ch. 2	Appeal to authority and false analogy
3	Ch. 3	Funding-driven motivated reasoning in source selection
4	Ch. 4	Weaponized correlation-vs-causation rhetoric
5	Ch. 5	The real gap between "no proof" and "no evidence"
6	Ch. 6	Testimonial, glittering generality, transfer, card stacking
7	Ch. 7	Reassuring framing of an identical, honestly worrying reality

STEP	CHAPTER	WHAT IT EXPOSED
8	Ch. 8	Industry-wide institutionalized consensus (TIRC)
9	Ch. 9	The full checklist applied end to end
COURSE COMPLETE Critical Thinking closes at 10/10 chapters — the second course in the Study Methodologies Subject, joining Research Methodology. Scientific Methodology and Mathematical Proofs remain as reserved sibling ideas for this same Subject, not yet fleshed out.		
CHAPTER 10 QUICK REFERENCE • The capstone deconstructed the real 1954 "A Frank Statement to Cigarette Smokers" tobacco industry advertisement using every prior chapter's own technique • Multiple real fallacies and propaganda devices operated simultaneously: appeal to authority, false analogy, testimonial, card stacking, and reassuring framing • The ad announced the real Tobacco Industry Research Committee, an institutionalized industry-wide consensus body • A real 1969 internal memo — "doubt is our product" — confirmed 15 years later that the 1954 statement was a deliberate doubt-manufacturing strategy, not a genuine scientific assessment		