

What Could Fool Us Into the Wrong Conclusion?

What could fool us into thinking we found the right cause, when we did not?

CARRY FORWARD An operational definition makes speech scoring repeatable, while patient-reported outcomes capture effects clinician scores can miss.	10-YEAR TAKEAWAY Bias is directional design or measurement error; confounding mixes effects; each threat needs a matched safeguard.
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Cells differentiate	Development sculpts	Cells move	Development can go wrong
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1. Observe the analogy before naming the biology

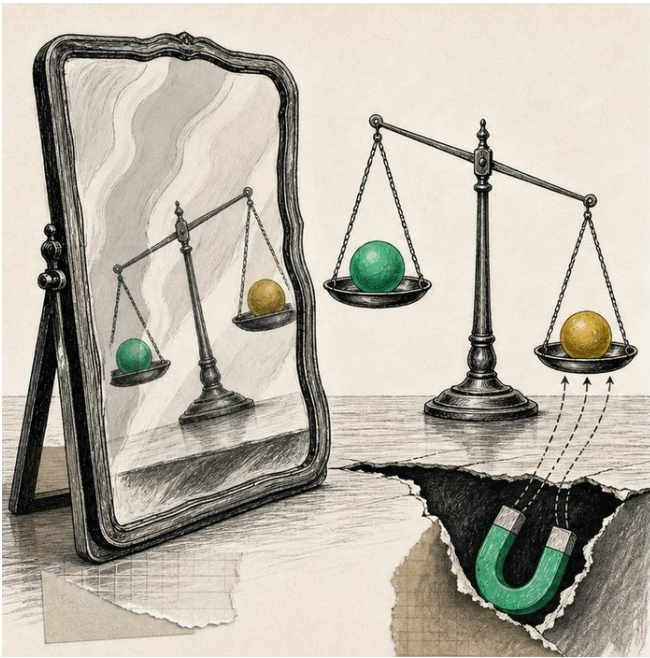


Illustration: A crooked mirror and a hidden magnet distort results in different ways

- 1. Which problem changes the measurement itself?
- 2. Which adds another cause linked to both sides?
- 3. Would a larger sample fix either problem?

2. Turn observations into rules

- 1. Rule 1: Name the direction and stage of each bias. Explain it in your own words.
- 2. Rule 2: Draw the confounder linked to exposure and outcome. Explain it in your own words.
- 3. Rule 3: Choose a safeguard that fits the threat. Explain it in your own words.

Where the analogy stops: Real studies can have many interacting biases and unmeasured confounders, not one visible mirror or magnet.

3. Map the rules onto the biomedical example



Biomedical teaching illustration: Red-team a speech study for selection, measurement, and confounding

Analogy step	Biology step	How the relationship stays the same
Crooked mirror	Measurement bias	
Missing participants	Selection and attrition bias	
Hidden magnet	Confounder linked to exposure and outcome	

4. Use the case evidence

ID	Finding supplied in the case	Why it matters
EXP16-E1	Earlier-repair participants are more likely to receive care at high-volume centers with strong speech services.	Center resources could confound an observational comparison.
EXP16-E2	Assessors know each child's group and expect earlier repair to work.	Expectation could create directional measurement bias.
EXP16-E3	Follow-up is 92 percent in one group and 71 percent in the other, with access-related reasons.	Differential attrition could change the comparison.

5. Make the clinical decision

You are the adversarial methods reviewer before data lock. The team says a sample of 5,000 makes bias and confounding disappear.

- A. Match each supplied threat with a design, measurement, or analysis safeguard.
- B. Accept the claim because large samples remove systematic error.
- C. List every possible bias without changing the protocol.

Decision. Choose the red-team response and propose one matched safeguard per evidence card.

Claim ceiling: You may reduce named threats. You may not claim adjustment removes all unmeasured bias or confounding.

Claim. State the choice you can defend.

Evidence. Use these labeled IDs: EXP16-E1 + EXP16-E2.

Reasoning. Explain why the evidence supports the claim and stays inside the claim ceiling.

6. Reduce the lesson to one lasting idea

Take-home. Bias is directional design or measurement error; confounding mixes effects; each threat needs a matched safeguard.

- 1. Why can a large sample still be biased?
- 2. How is a confounder different from measurement bias?

Glossary

Term	Plain-English definition
bias	A systematic error in how data is collected or interpreted that tilts results in one direction, making conclusions less accurate or unfair.
confounding	When a hidden third factor influences both the suspected cause and the outcome, making a link look real when it may be misleading.
blinding	Keeping participants, researchers, or both unaware of who got which treatment so expectations cannot bias the results.
recall bias	A study error where people with a condition remember past exposures differently than people without it, distorting the results.
surgeon-as-confounder	A study bias where differences in patient outcomes come from which surgeon operated rather than from the treatment being tested.

Next lesson unlock

We answered today's question: bias, confounding, and weak blinding can all fool us. But even a careful single study can be a fluke or can disagree with the next study. How do we gather every study on a question and combine them into one trustworthy answer? We chase that next time.

The journal links on the lesson page are optional. Everything required for this guided-notes set is already supplied here and in the case file.