

به نام یگانه پروردگار



Research Methodology

Errors

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Errors in Research

Systematic

- Cause in:
Invalidity &
Spurious
association

Random

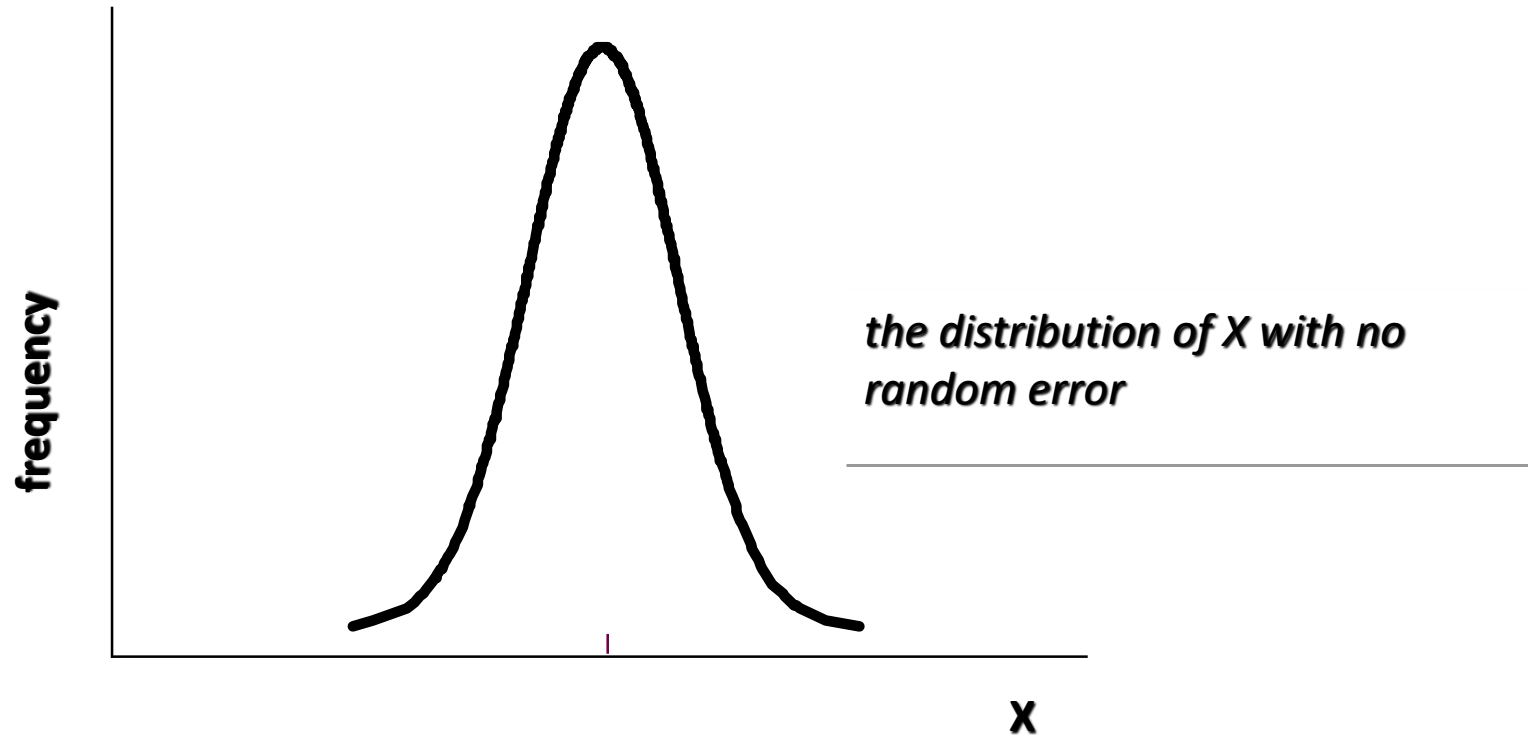
- Cause in:
unreliability &
Diluted
association

Confounding

- Cause in:
a relationship
but not causal
association

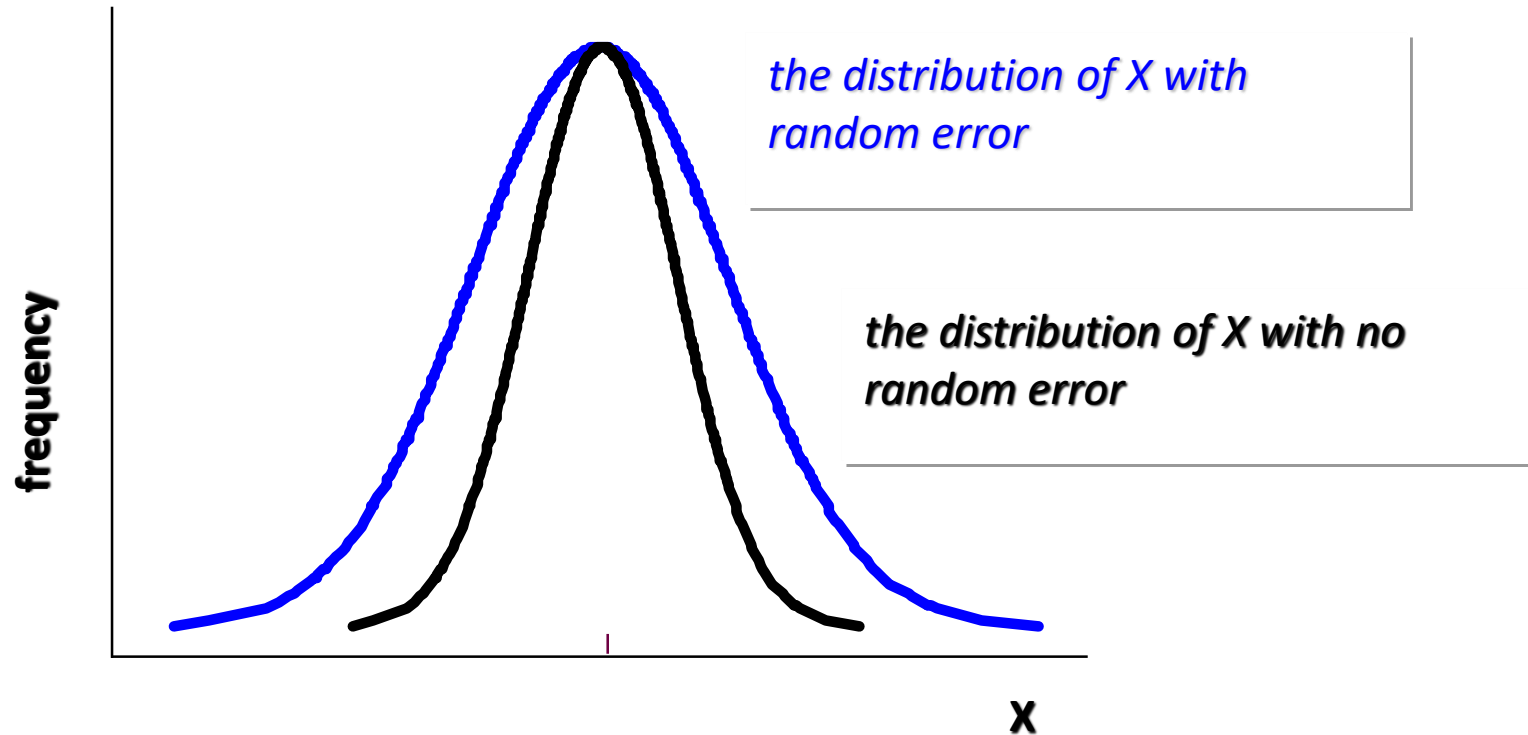
Random Error

Deviations from the true value that occur in a random chance pattern



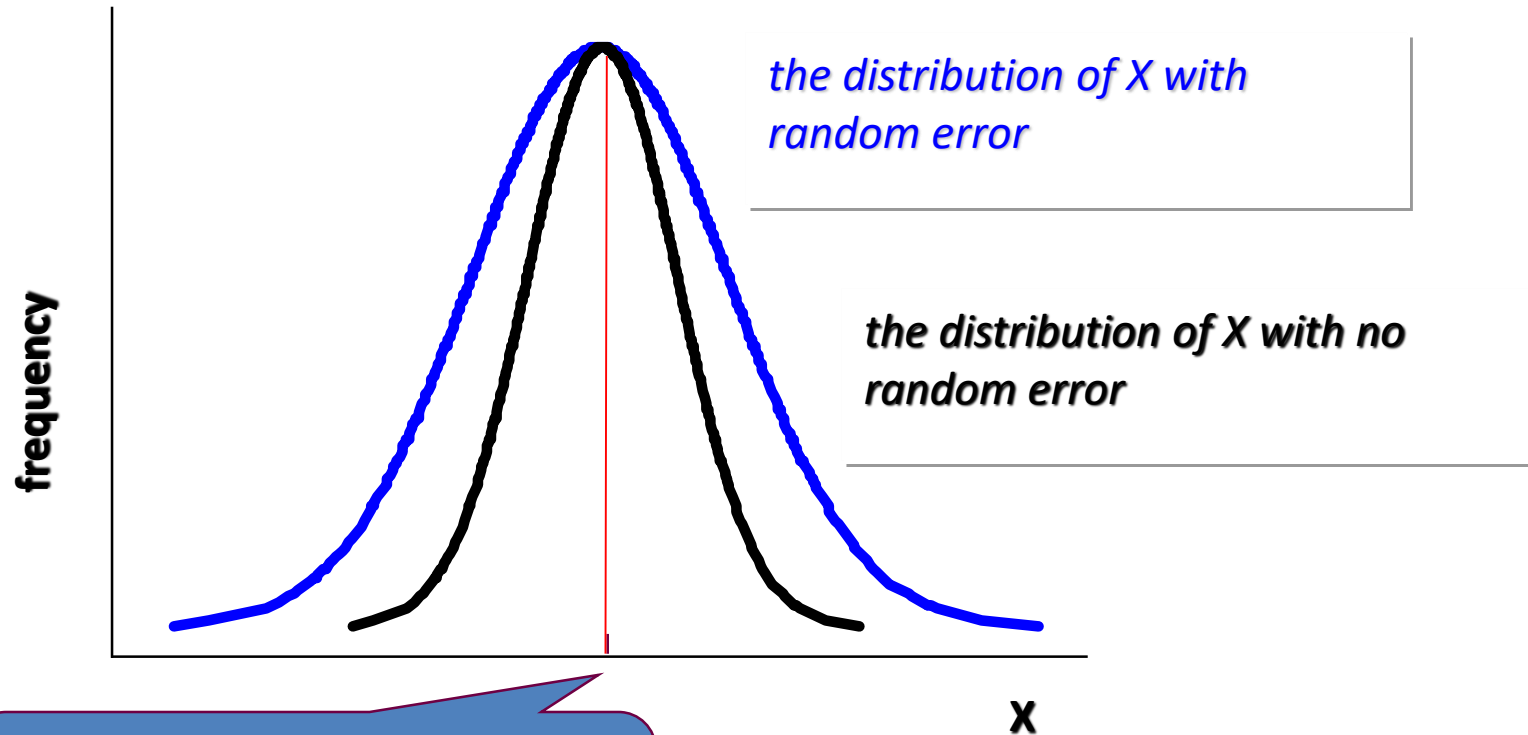
Random Error

Deviations from the true value that occur in a random chance pattern



Random Error

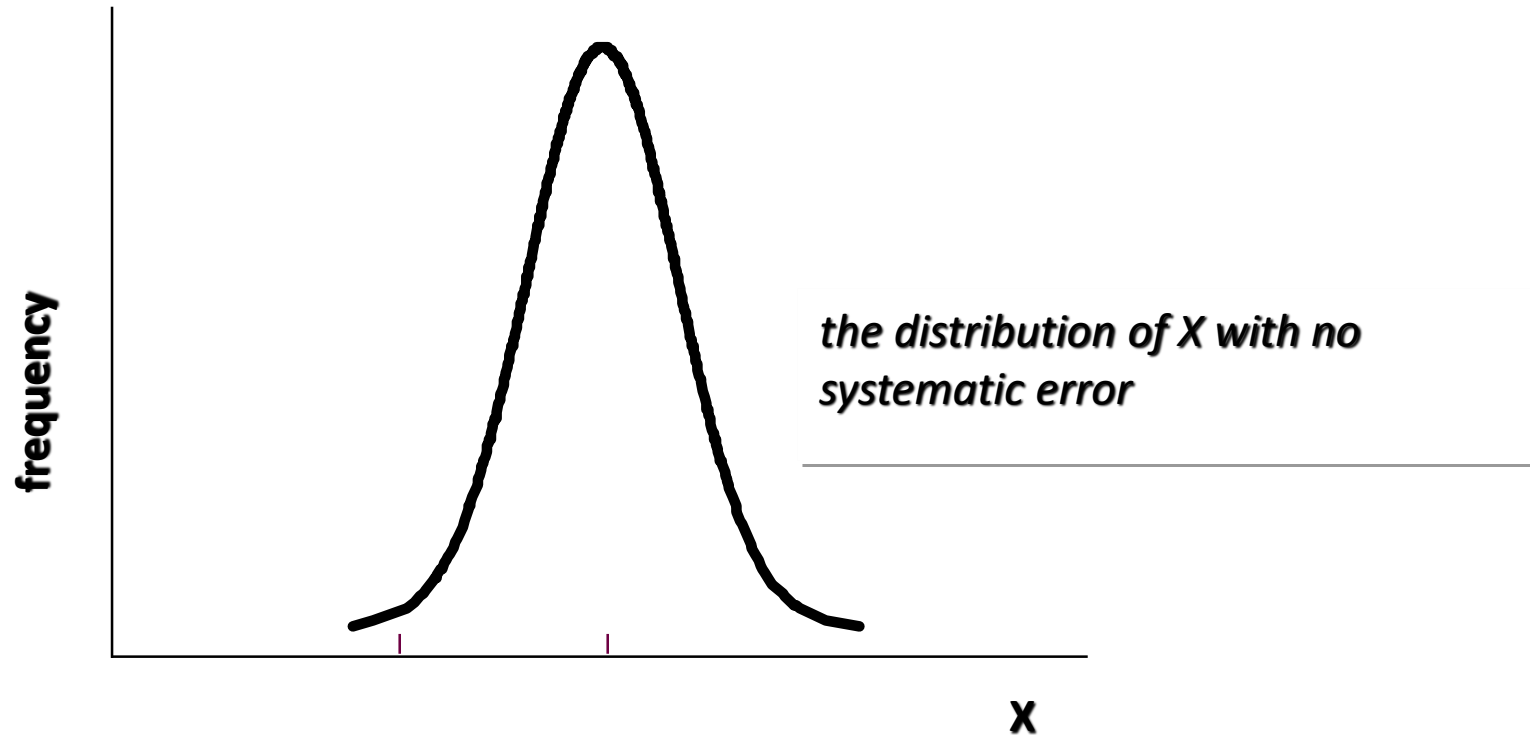
Deviations from the true value that occur in a random chance pattern



Notice that random error doesn't affect the average, only the variability around the average

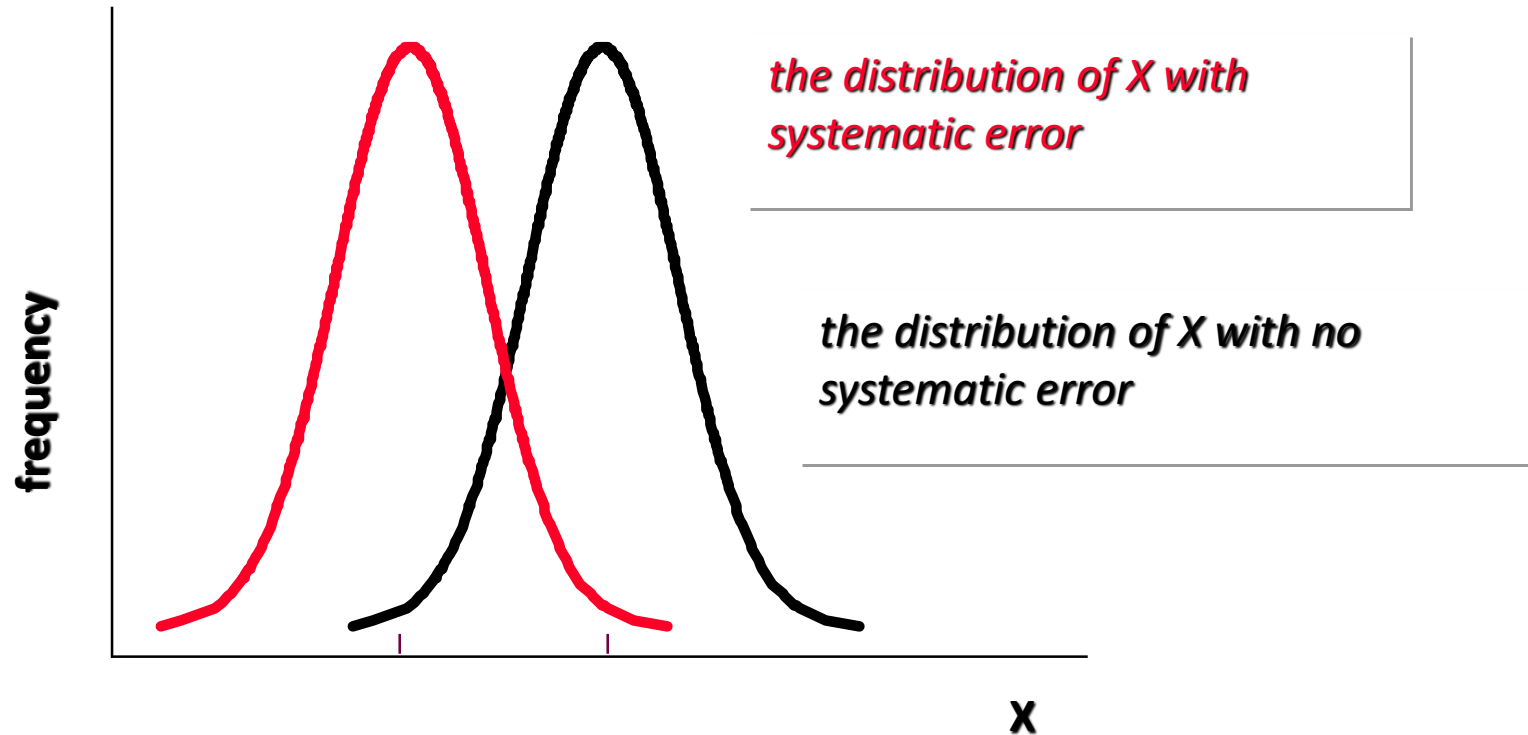
Systematic Error

Any process at any stage of inference which tends to produce results or conclusions that differ systematically from the truth



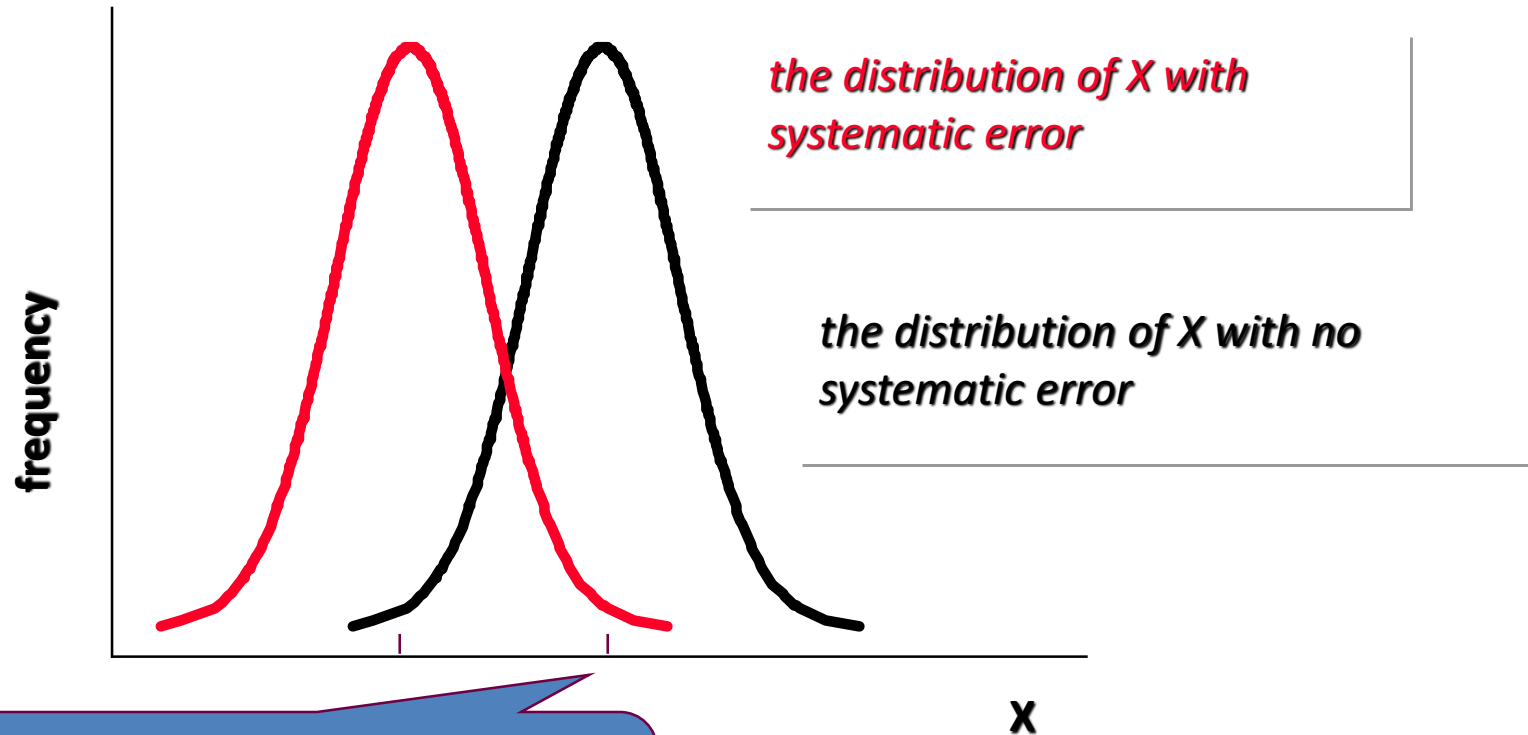
Systematic Error

Any process at any stage of inference which tends to produce results or conclusions that differ systematically from the truth



Systematic Error

Any process at any stage of inference which tends to produce results or conclusions that differ systematically from the truth



Notice that systematic error does affect the average -- we call this a bias

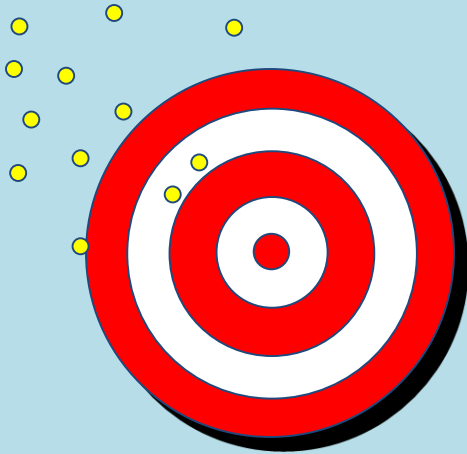
The Error Component

$$X = T + e$$

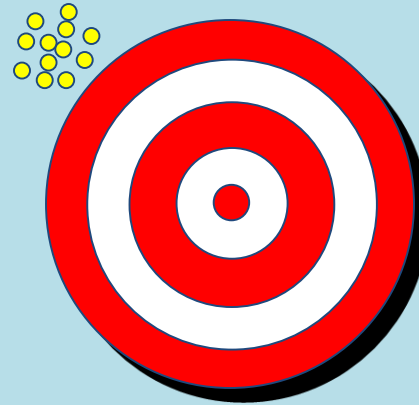
Two Components:

- e_r (Random Error)
- e_s (Systematic Error)

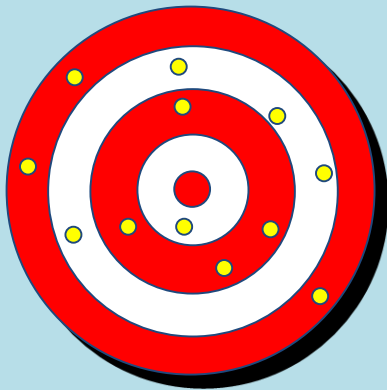
RELIABILITY AND VALIDITY



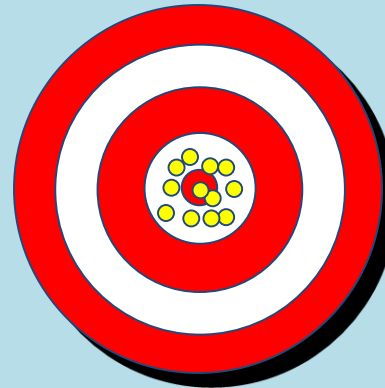
Not reliable
Biased (Not valid)



Reliable
Biased (Not valid)



Not reliable
Somehow valid



Reliable
Valid

In Random error measurement is not reliable.

In Systematic error measurement is biased (not valid).

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Target Population

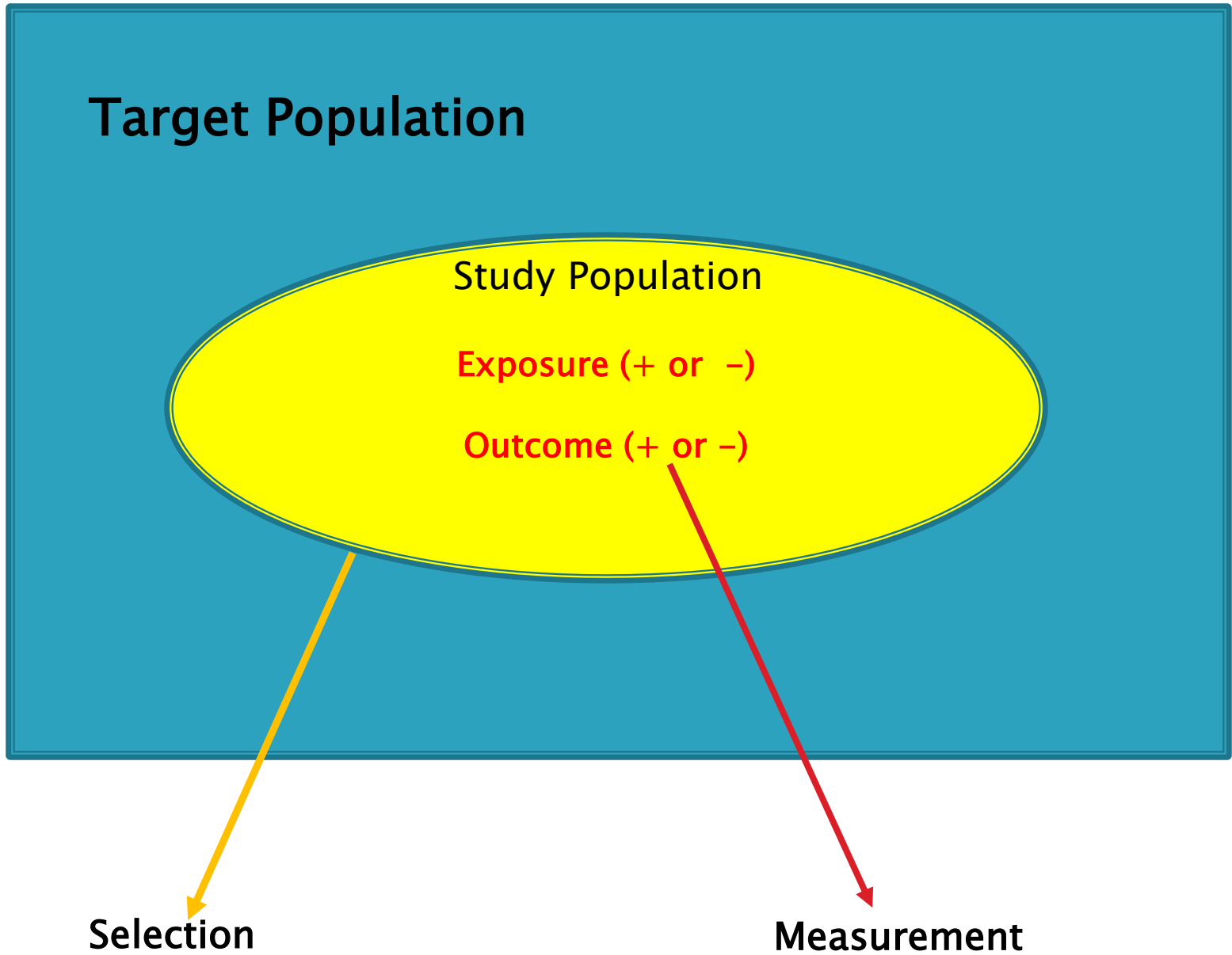
Study Population

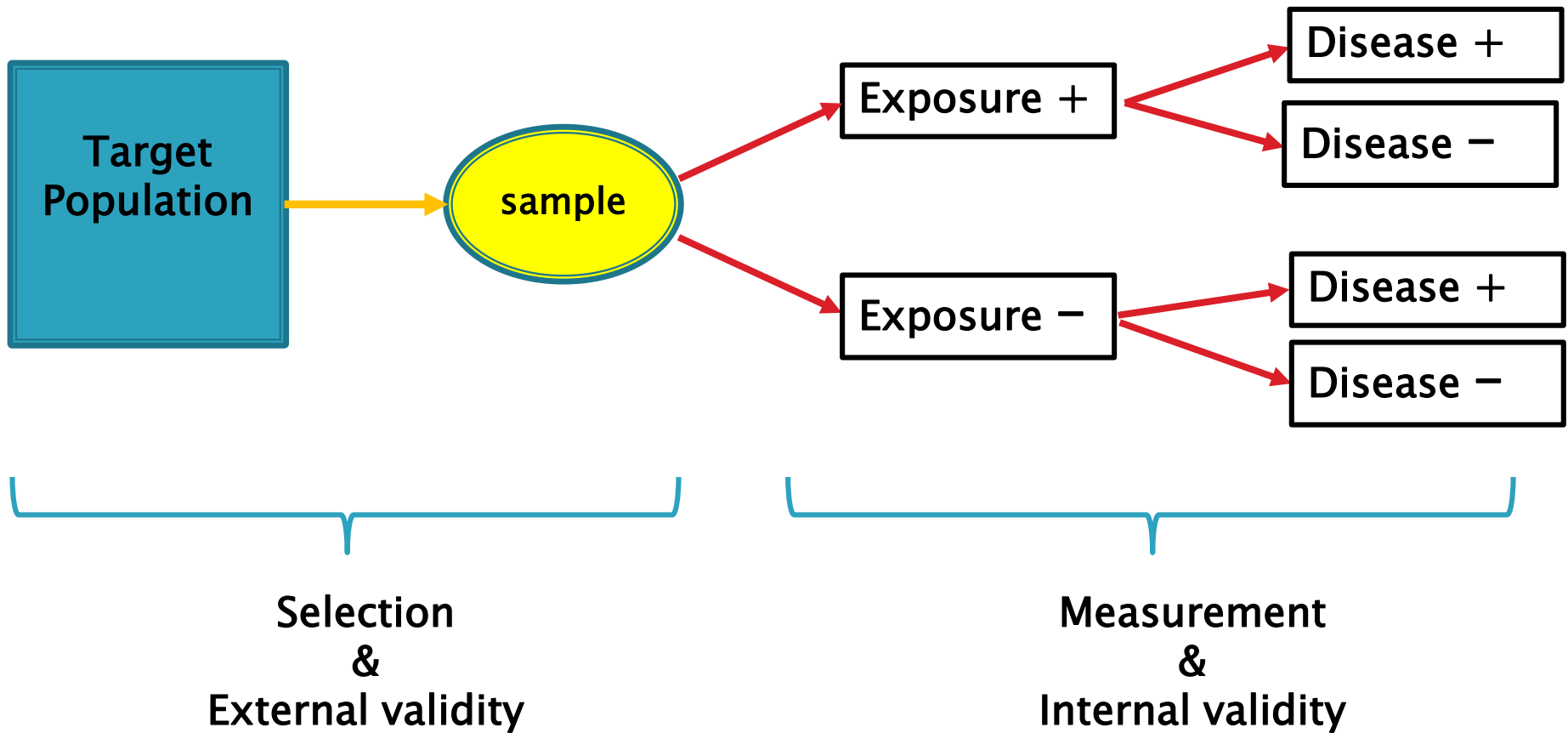
Exposure (+ or -)

Outcome (+ or -)

Selection

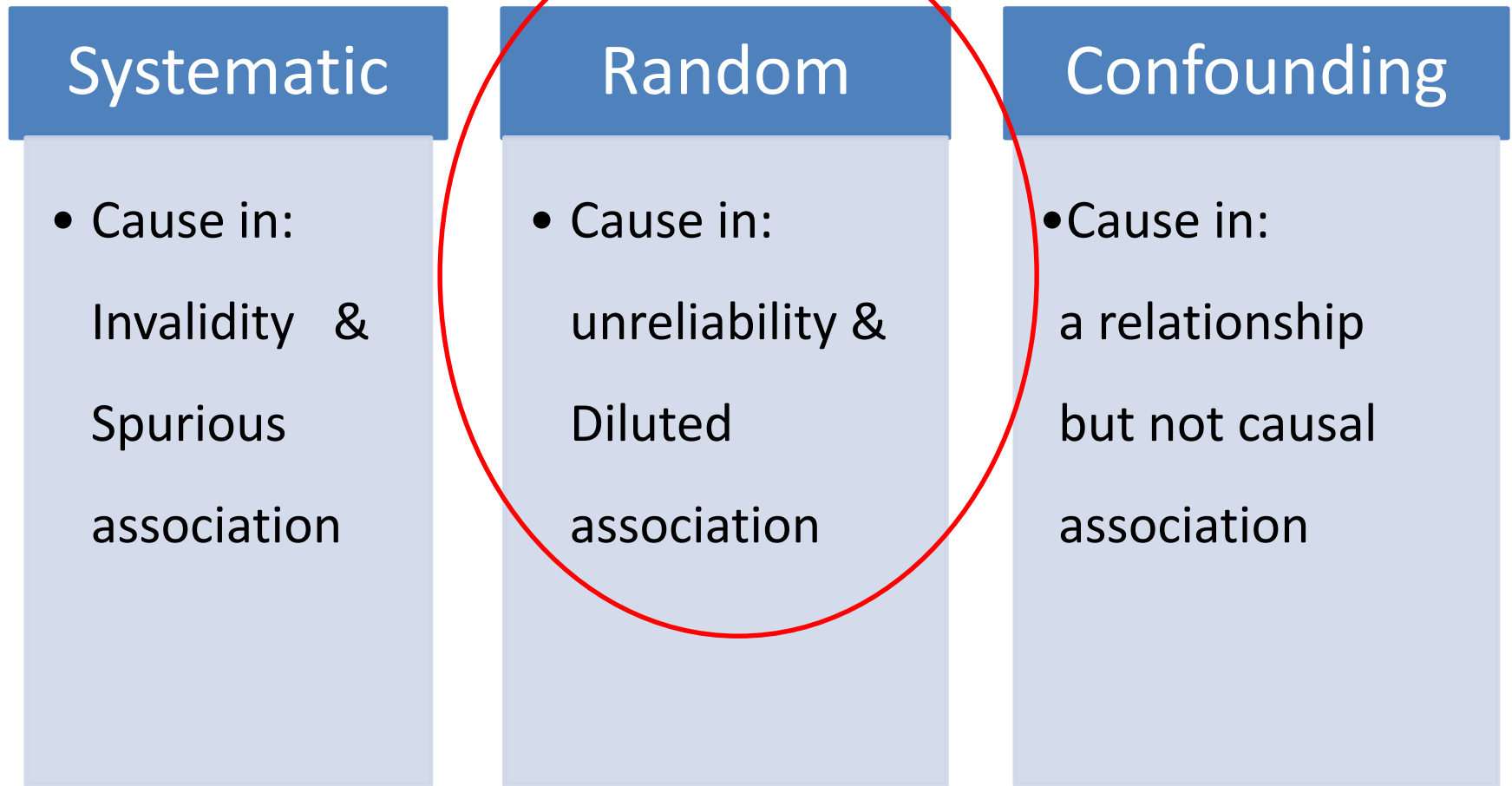
Measurement

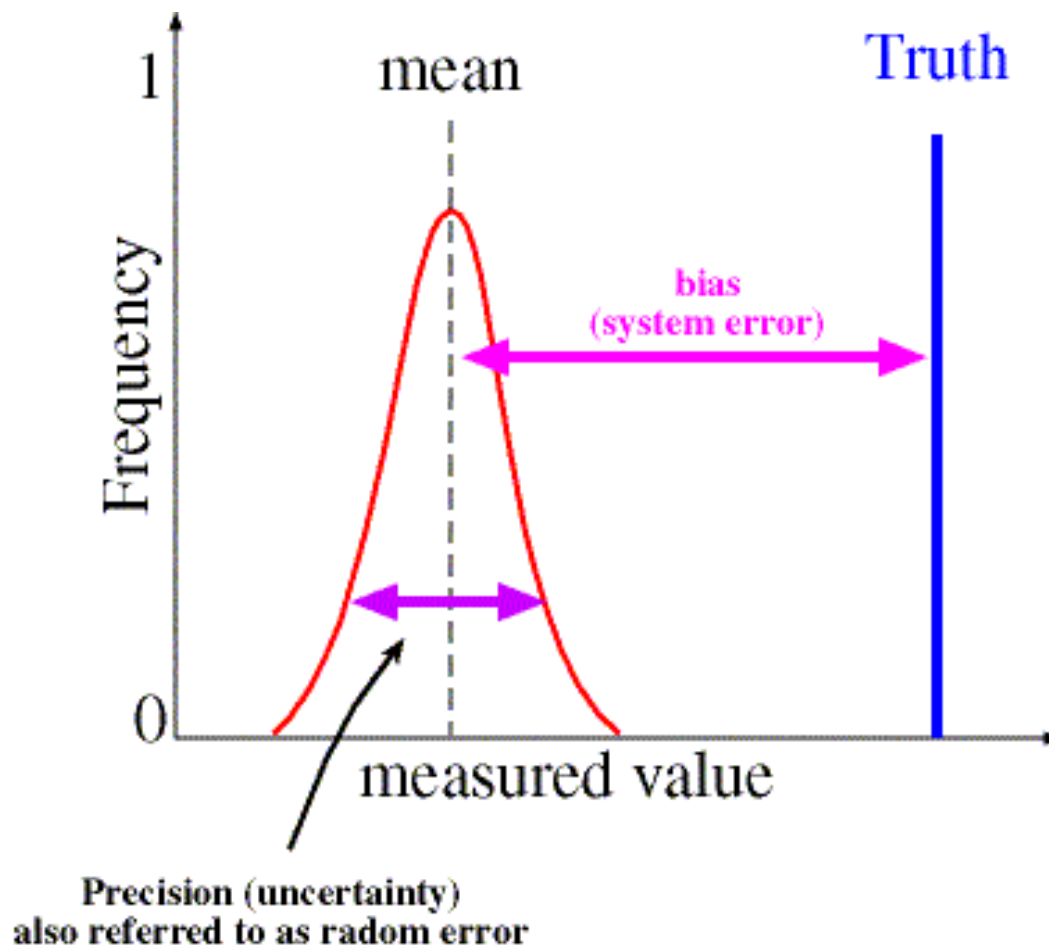




- Systematic errors nearly always cannot be corrected.
- Sometimes they can be estimated using some advanced epidemiological methods.

Errors in Research





- Random errors almost always cannot be corrected.
- Routinely, they are estimated using statistical methods (i.e. Confidence Interval and p-value)

(Background)

Errors in Research

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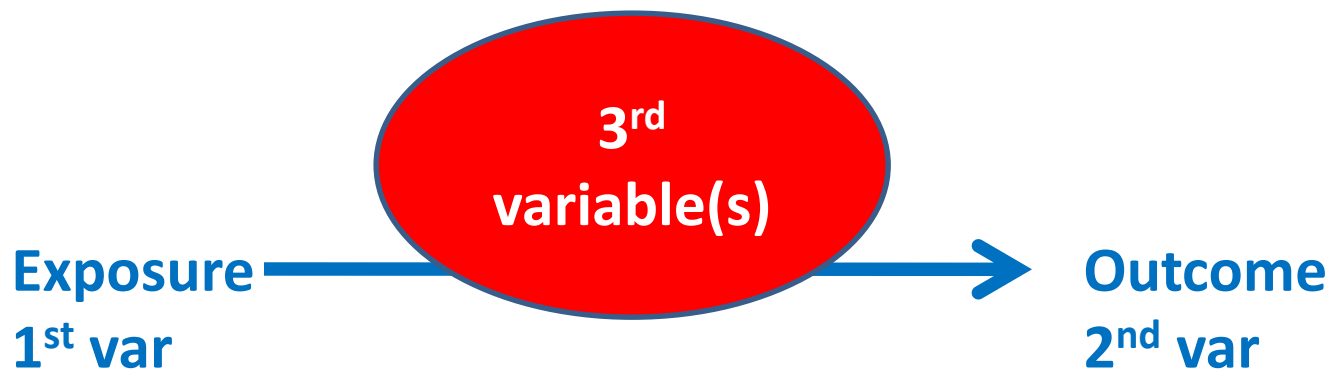
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Considering 3rd Factor(s) in Causality



Kinds of RELATIONSHIPS OF **3rd** VARIABLE(S) IN RESEARCH

☐ **CONFOUNDING**

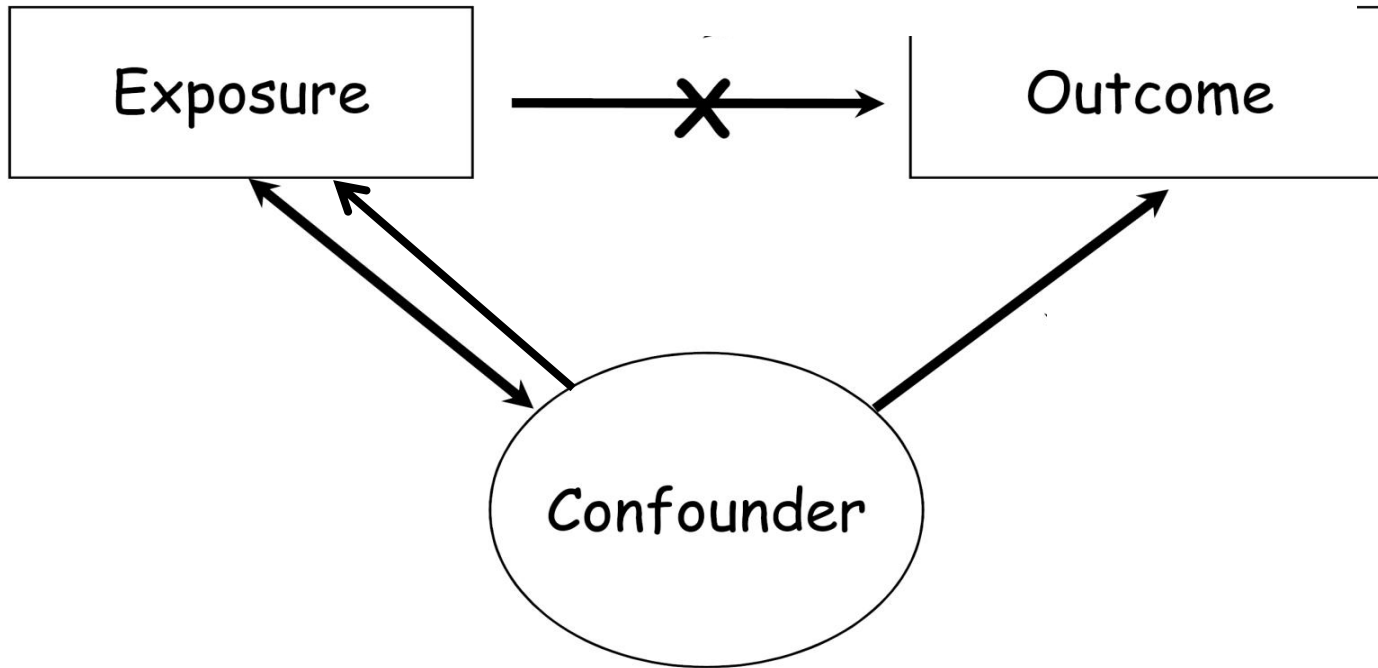
✓ **MEDIATION**

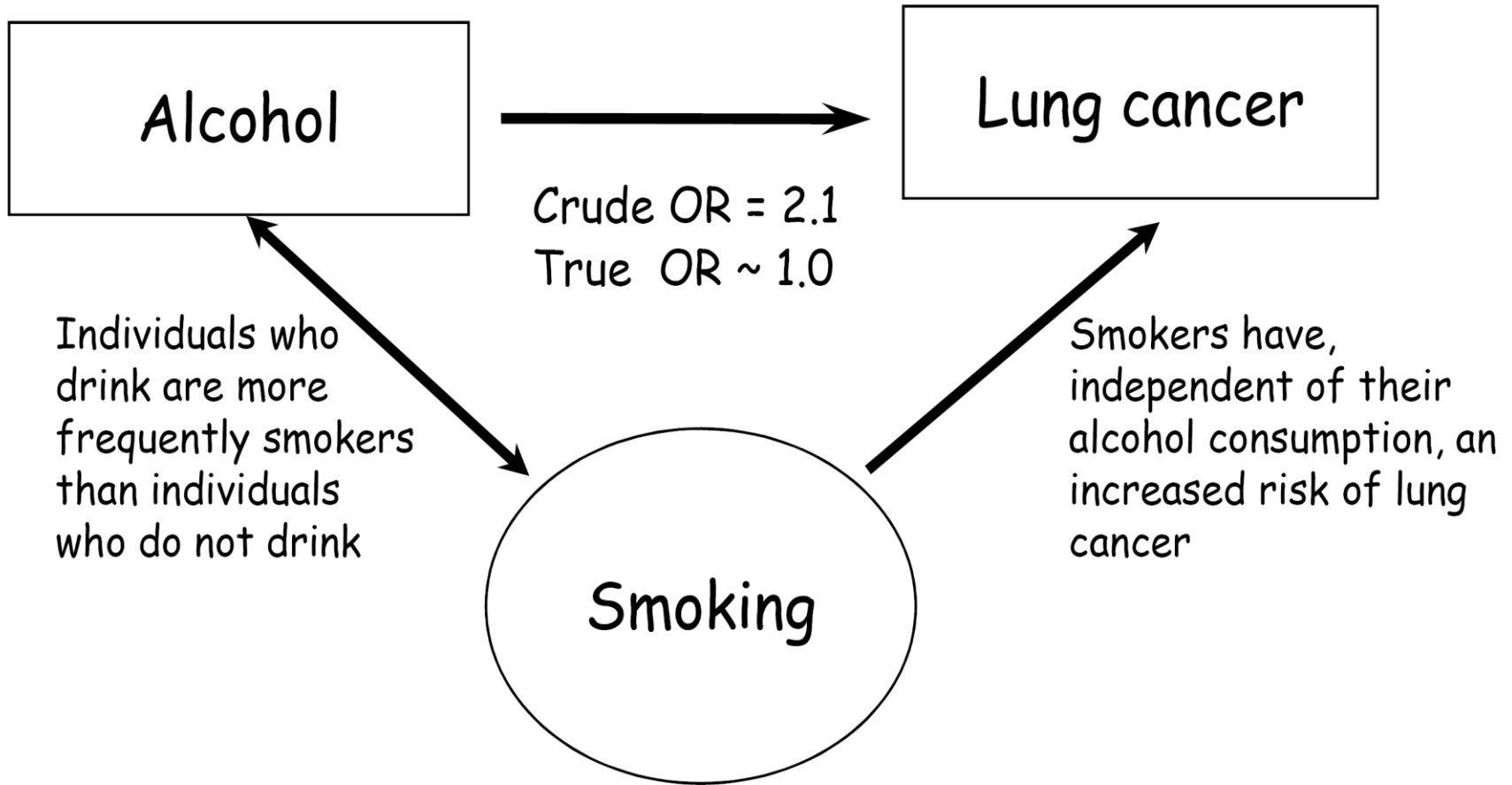
✓ **COLLINEARITY**

☐ **EFFECT MODIFICATION**
(INTERACTION OR MODERATION)

CONFOUNDING

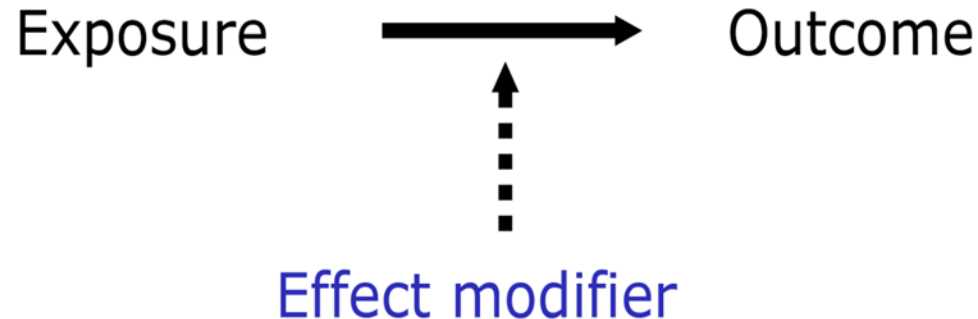
A confusion of effect





Some points in:

EFFECT MODIFICATION



- The effect of one factor on outcome is modified by levels of another factor
- Important to present and discuss

Some points in:

Effect Modification

- ✓ It's not a bias.
- ✓ Global analysis / Crude OR is meaningless.
- ✓ Results should be analysed in each stratum *separately*.

Control of confounding

IN DESIGN

- Randomization
- Restriction
- Matching

IN ANALYSIS

- Standardization
- Stratification

- Multivariate analysis

The most applicable method

Conclusion

Research by Love . . .

