Quantitative Sociological Analysis

Prefacing Statistics:
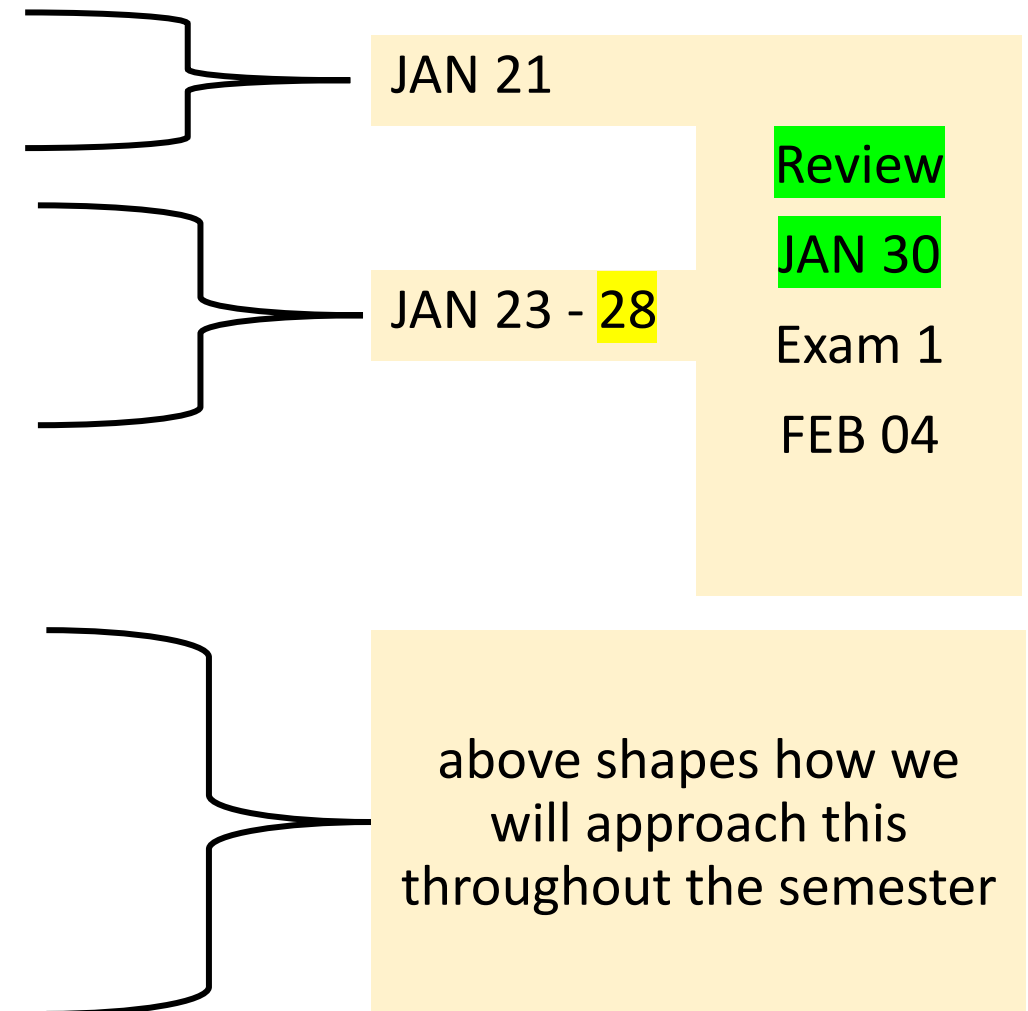## Science and the Research Process

Part 3

January 28, 2025

Science: a **process** of organizing, and acquiring new, knowledge

Steps in the process

1. Start with a perspective
2. Select a theory
3. Derive a research proposition
4. Derive a research question
5. Derive a hypothesis
6. Find or collect data
7. Analyze data
8. Report results & Answer question
9. Interpret results in terms of theory
10. Draw implications for theory

JAN 21

JAN 23 - 28

Review
JAN 30

Exam 1

FEB 04

above shapes how we will approach this throughout the semester

Part 3

Learning objective: begin to understand why perspective and theory are necessary for explaining relationships between variables

recognize how:

hypotheses speak toward expected strength and direction of relationships

study results are used to empirically evaluate hypotheses

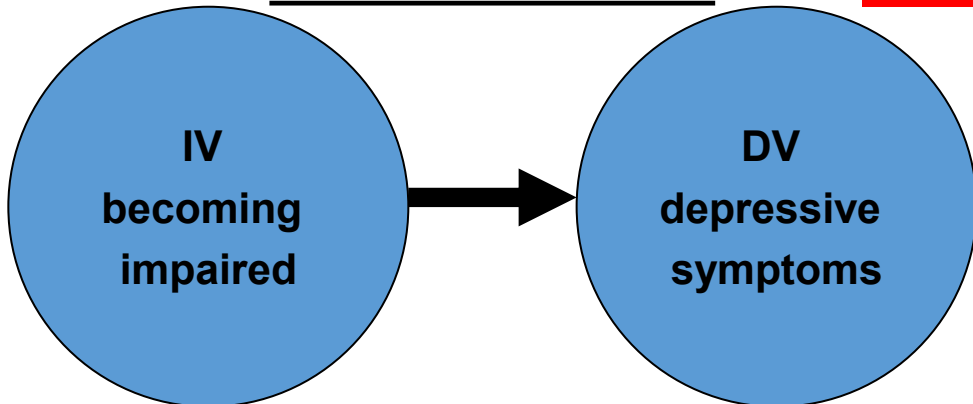whether explanation is reasonably supported largely depends on study design

Takeaway: teaching quantitative methods without emphasizing perspective and theory would be like teaching you to drive with your eyes closed
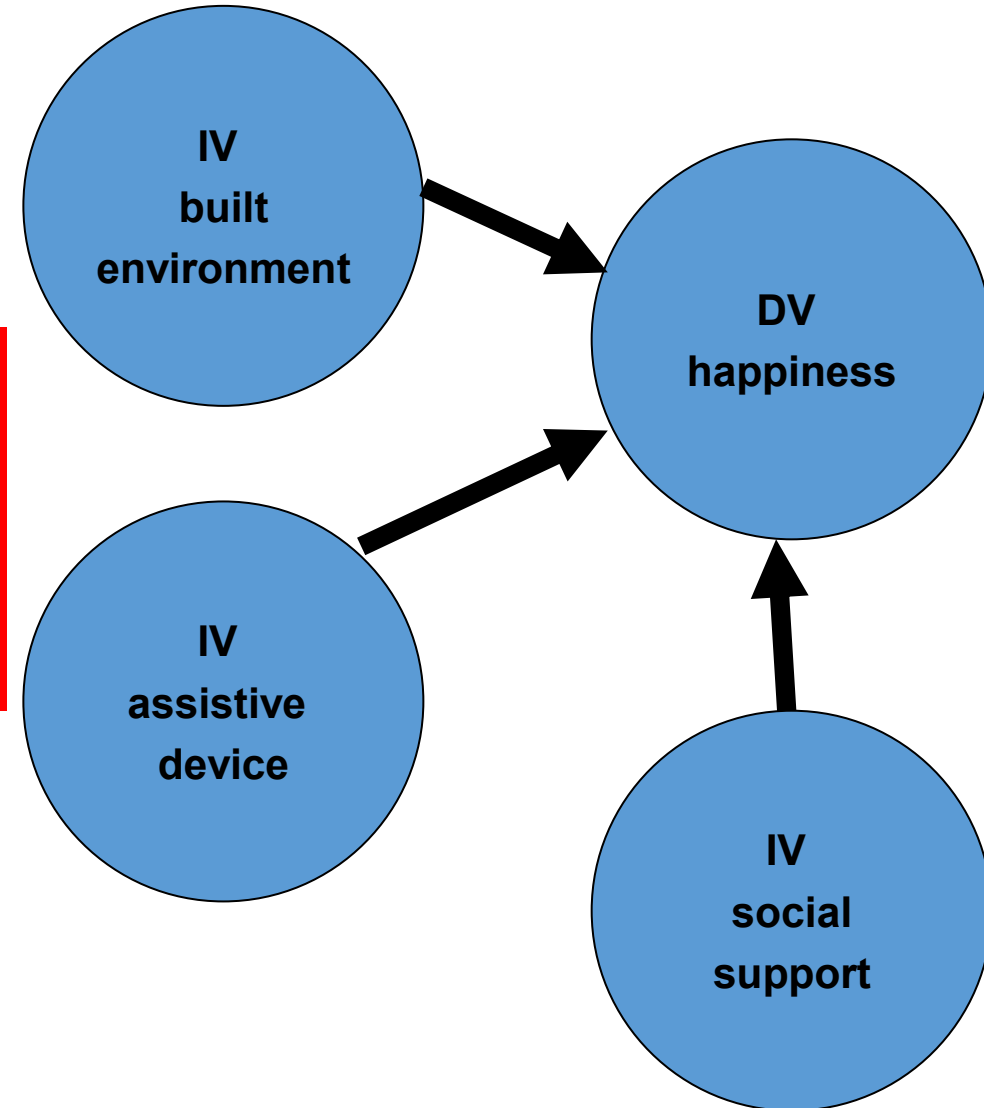
IVs and DVs: our examples

provides some logic to explain how variables affect one another in terms of *relationships* between cause (IV) and effect (DV)

ended here last class

social model

IV built environment → DV happiness

IV assistive device → DV happiness

IV social support → DV happiness

medical model

IV becoming impaired → DV depressive symptoms

# Wait, what's a relationship?

- specific type of <u>association</u>
  - any connection between two or more variables

- Thus, need to know about association to test a hypothesis
  - association is established via statistics

- We'll discuss "statistics" later. For now...
  - What's a relationship?
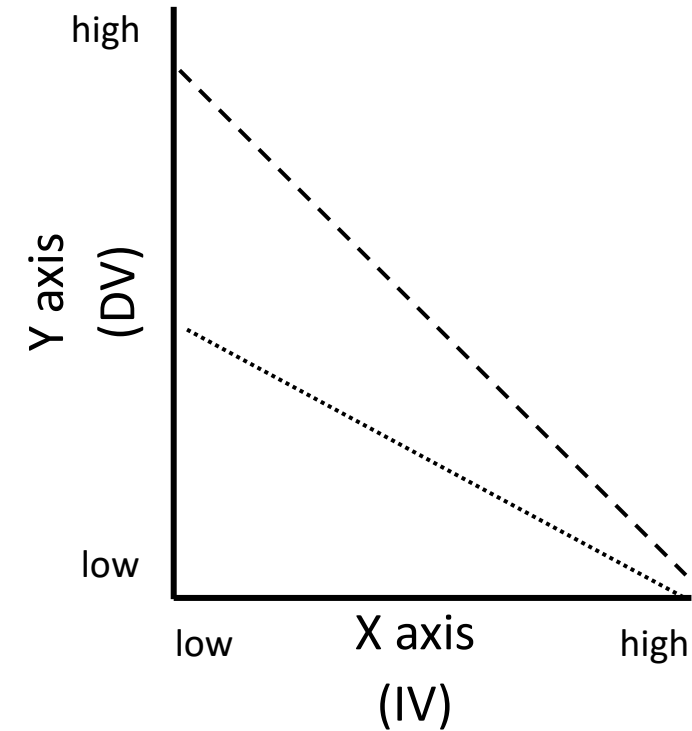
Relationship

- the *strength* and *direction* of association between variables
  - also known as a <u>correlation</u>

- <u>Strength</u>: how closely the variables are associated
  - sometimes called <u>magnitude</u>

- <u>Direction</u>: how the variables move in *relation* to each other
  - same direction: positive correlation
  - opposite direction: negative correlation

Relationships: direction and strength
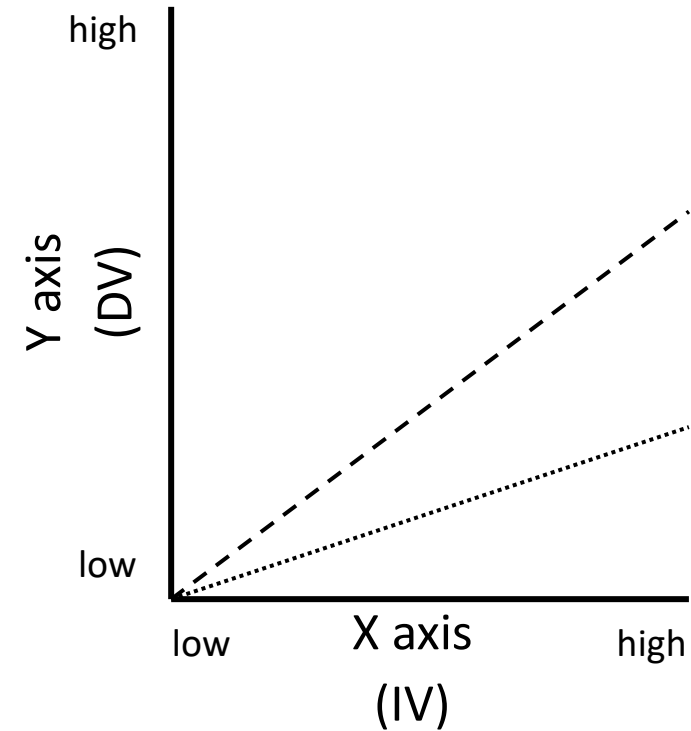
positive   negative
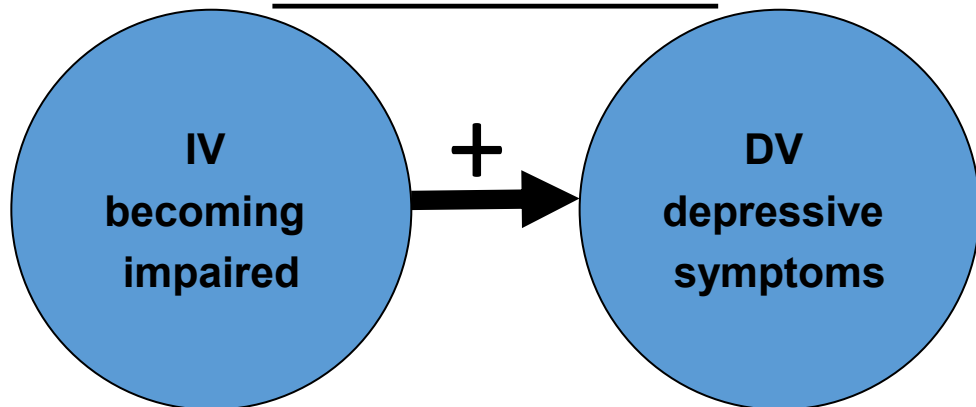

anyone recall ever learning....

y = mx + b

Relationships: our examples

social model
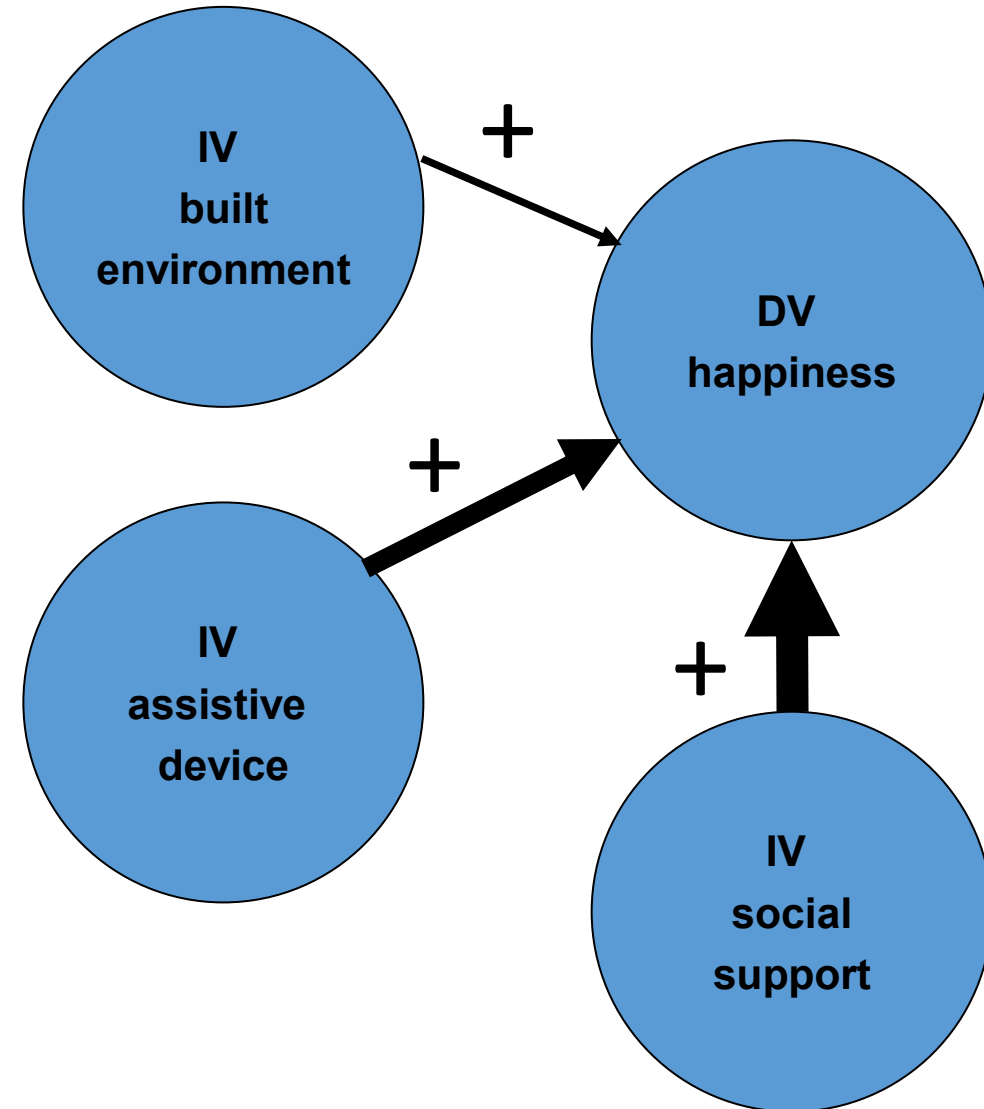
Let's try interpreting some of these relationships.

- <u>strength</u> denoted by arrow width
- <u>direction</u> denoted by sign
  - arrow denotes causal pathway

medical model

Hypotheses: were results in/consistent?

- Was <u>X</u> (IV) related to <u>Y</u> (DV) as expected?
    - hypothesized strength and direction

perspective	[step 3] research proposition	[step 4] research question	[step 5] hypothesis
medical	Becoming disabled leads to the proliferation of mental illness.	How does becoming disabled impact mental illness?	People who become impaired in one or more ADLs will report higher levels of depressive symptoms.
social	Accommodations are important for well-being among people who develop a disability.	How do accommodations impact the well-being of people who develop a disability?	The importance of accommodations for happiness among individuals who develop a disability will differ by type, with social support being the most important, followed by the provision of an assistive device, and then improvements to the built environment.

- If so, does that mean X (IV) *caused* Y (DV)?
    - Not necessarily, we need to know a lot more…

correlation ≠ causation

Causal relationship: criteria

- correlation
  - Was there a relationship between IV (X) and DV (Y)?

- temporal order
  - Did a change in IV (X) occur before a change in DV (Y)?

- no spuriousness
  - Were IV (X) and DV (Y) directly related?
    - cause not due to a third variable (Z)

- plausible
 - study design reflected theoretical mechanism

Causal relationships: forthcoming

- correlation
  - more on this when we get to statistics
- temporal order
  - Issues in social sciences? (e.g., disability $\rightarrow$ depression)
- no spuriousness
  - next slide
- plausible: theoretical mechanism
  - a bit more after next slide

Spuriousness: when variables are associated but the relationship is not causal

study results
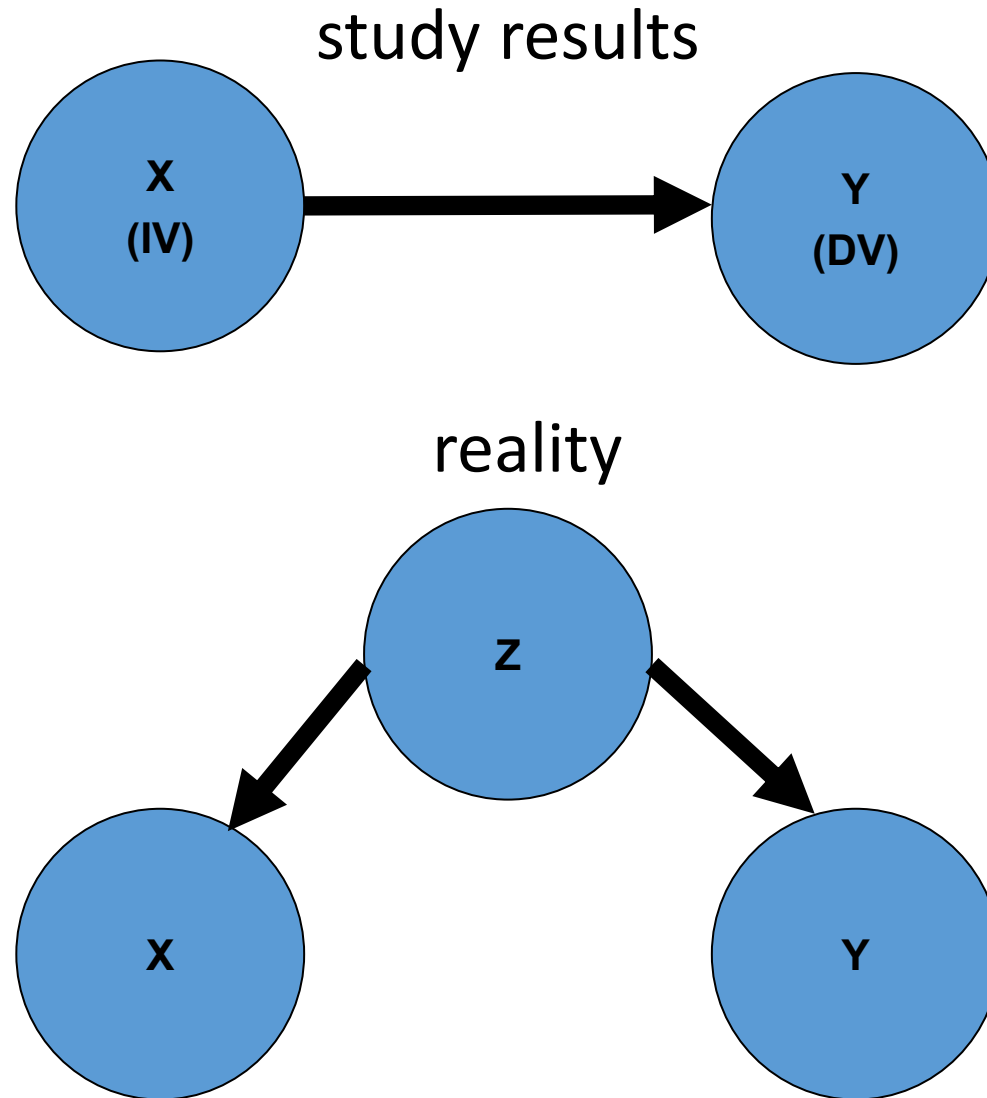
reality

# Spuriousness: our example

study results
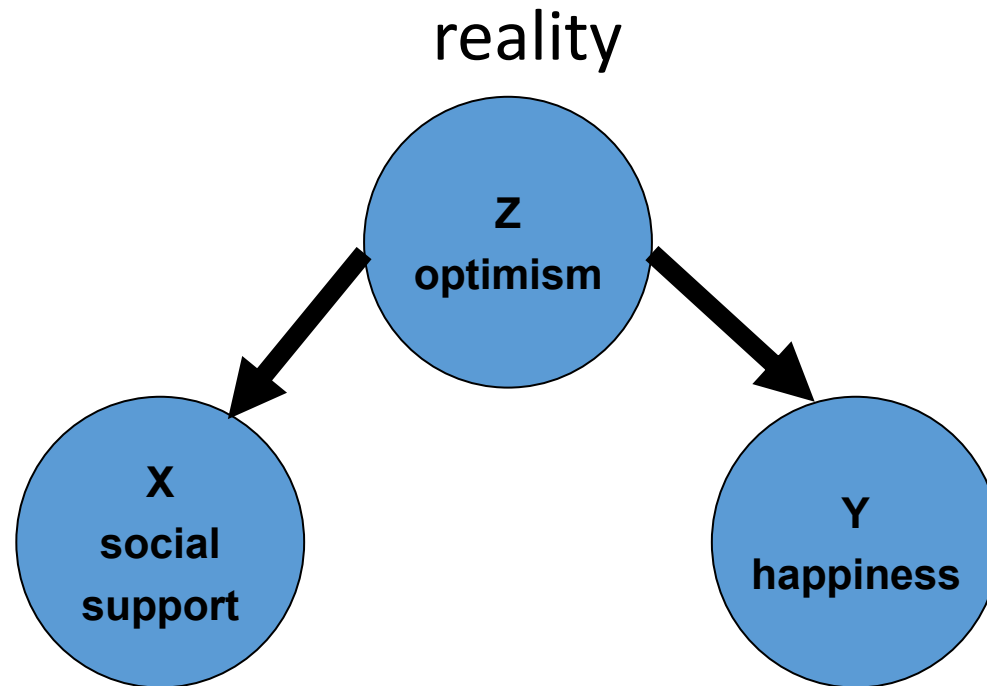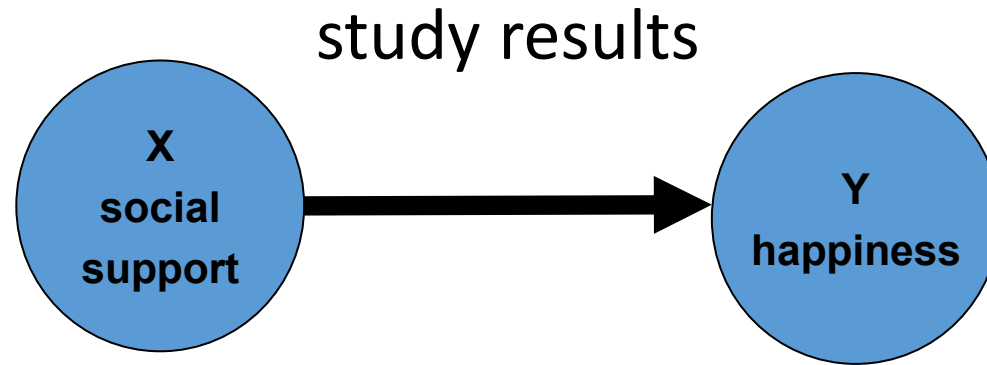
reality

How might this shed some light on why theory is key for the scientific process?

Plausibility:

- contingent on how closely study design matches "reality"
  - outlined by perspective
    - specified by theory

- can never really know for sure
  - understanding of "reality" based on scientific knowledge
    - and, hypotheses can only be rejected or failed to be rejected

- acceptable plausibility achieved when limitations, mismatch between study design and assumed reality, deemed reasonable
  - peer-review process

Let's revisit the scientific process: biases

- recall how data or statistics w/o theory ≠ science
  - let's break this down further

- w/o theory to inform study design and data analysis
  - claims are especially suspect to bias
    - two types of bias particularly relevant to this course include…
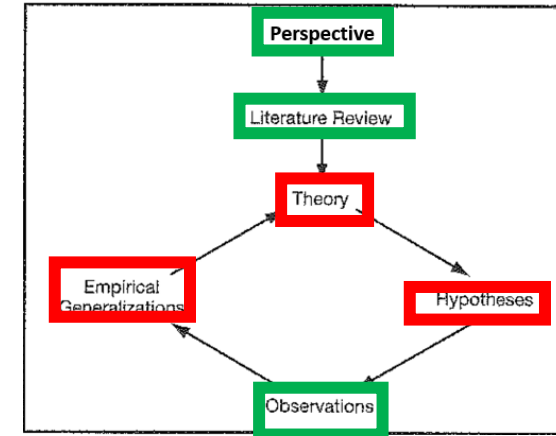

- <u>Confirmation Bias</u>
  - (un)conscious tendency to search for, interpret, or report information that is consistent with one's existing beliefs

  recall why motivating factors important to critique when you evaluate claims supported by a particular perspective

- <u>Selection Bias</u>
  - occurs when the observations, sample, does not accurately reflect the whole, population, it was intended to represent

  consider this topically unrelated but helpful example

Let's revisit the scientific process: fallacies

• recall how data or statistics w/o theory ≠ science
  • let's break this down further

• w/o theory to inform study design and data analysis
  • claims are especially suspect to fallacies
    • two types of fallacies particularly relevant to this course include…
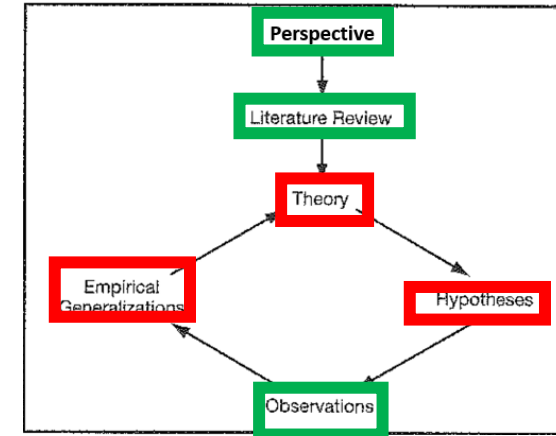
• <u>Ecological Fallacy</u>
  • occurs when individual-level claims are drawn from group-level observations
    • Examples?   see here for further explanation

• <u>Individualistic Fallacy</u>
  • occurs when group-level claims are drawn from individual-level observations
    • Examples?   underlies most "isms"

Biases and fallacies: another example

- How might popular claims about how to live a long and healthy life be suspect to…
  - confirmation bias
  - selection bias
  - ecological fallacy
  - individualistic fallacy

[exciting music playing]

0:28 / 1:37

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