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Evaluating Evidence:
Becoming a Smart Research Consumer

9. Establishing Causal Relationships

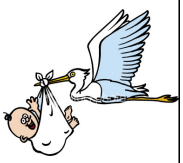
Reminder: Turn on your I<CLICKER

Why does correlation not imply causation?

- **X could cause Y**
- **Y could cause X**
- **The correlation could be spurious**
  - **A third unseen variable is actually responsible for the relationship**
- **The correlation could be a chance occurrence**

Correlation ≠ Causation

- Example #1
  - In Taiwan, a positive relationship has been found between owning a toaster (A) and low birth rates (B)
  - Does this mean that family planners in Taiwan should buy young couples toasters to reduce the birth rate?
    - Does A ➔ B?
  - Why not?
  - Which of the other two necessary conditions for a causal relationship is not met?
    - **Probably there are other variables that covary with A. Like what?**
  - **Most likely, these variables are the real causes**



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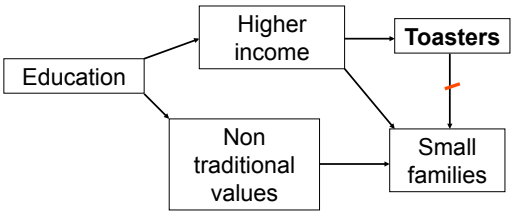

Correlation ≠ Causation

- Example #2
  - Statistics show that people who live in Arizona (A) are more likely to die of lung disease (B) than residents of any other state.
  - Does this mean that the air in Arizona is especially polluted, causing more lung disease (A➔B)?
- Why not?
- Which of the other two necessary conditions for a causal relationship is not met?
  - **Probably**
    - **there are other variables that covary with A. Like what?**
    - **lung problems may precede living in Arizona**
- Most likely, the real causal chains are...

Correlation ≠ Causation

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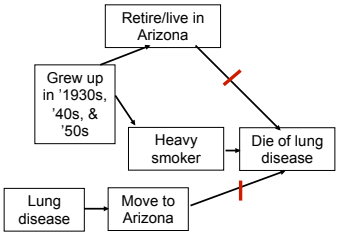
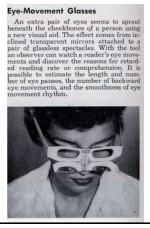


Correlation ≠ Causation

- (Non obvious) Example #3
  - It was discovered that those who were poor readers (B) scanned text with their eyes in irregular ways (A)
    - instead of scanning left to right, line by line, their eyes would wander all over the page
  - It was concluded that correcting irregular eye movements (A) would improve reading skills (B) (i.e., A➔B)
    - and many expensive remedial eye-movement programs were begun
  - They turned out to result in no improvement in reading.
- Why not? What was wrong with the inference that A➔B?
- Which of the other two necessary conditions for a causal relationship is not met?
  - **Probably**
    - **irregular eye movement is a symptom of inability to read, not a cause**
    - **you don't cure the disease by treating the symptoms**
- Most likely, the real causal chain is...


Eye-Movement Glasses

An extra pair of eyes seems to sprout beneath the cheekbones of a person using a new visual aid. The effect comes from inclined transparent mirrors attached to a pair of glassless spectacles. With the tool an observer can watch a reader's eye movements and discover the reasons for retarded reading rate or comprehension. It is possible to estimate the length and number of eye pauses, the number of backward eye movements, and the smoothness of eye movement rhythm.

Correlation ≠ Causation

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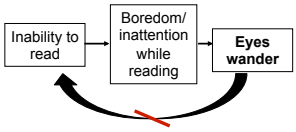
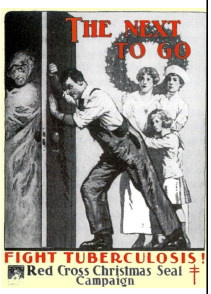


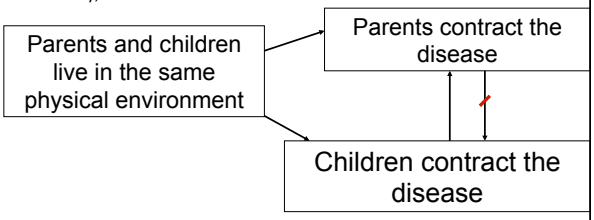
Correlation ≠ Causation

- (Non obvious) Example #4
  - Early public health studies showed that when parents had tuberculosis (A), the probability was higher that their children also would get the disease (B)
  - Is it reasonable to conclude that something about the parents (e.g., the genes they pass on to their children) make their children more vulnerable to the disease?
    - that parent's vulnerability ➔ children's vulnerability?
- Why not?
- Which of the other two necessary conditions for a causal relationship is not met?
  - Probably
    - **there are other variables that covary with A. Like what?**
      - **Like living in the same environment, and being exposed to the bacteria that causes the disease**
- Most likely, the real causal chain is...



Correlation ≠ Causation

- (Non obvious) Example #4
- Most likely, the real causal chain is...



Correlation ≠ Causation

- (Non obvious) Example #5
  - Pellagra was once a serious disease, especially in the American South and in South America
    - Symptoms include sensitivity to sunlight, diarrhea, insomnia, and red skin lesions
  - The poorest people, who also had very poor sanitation (A) were the most likely to contract pellagra (B)
  - Is it then reasonable to conclude that improving sanitation will reduce the level of pellagra (i.e., that A➔B)? Why or why not?
- Which of the other two necessary conditions for a causal relationship is not met?
  - **Is it likely that pellagra causes poorer sanitation (that B➔A)?**
    - **Not likely, so...**
  - **Probably is that some other variable covaries with the poor sanitation, like what?**
    - **Like poverty, and a poor diet**
- Subsequent research has shown that the actual causal chain is...

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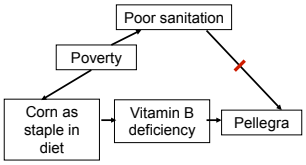

Correlation ≠ Causation

- (non obvious) Example #6
  - A study shows a negative correlation between high school teacher salaries (A) and the mean SAT score of students from their high schools (B)
    - students from schools with higher paid teachers got lower SAT scores
  - Does it make sense to lower teacher salaries to improve SAT scores (i.e., to conclude that A➔B)? Why or why not?
- Which of the other two necessary conditions for a causal relationship is not met?
  - **Probably some other variable covaries with the poor teacher salaries, like what?**
    - **Like poverty, interest in college and taking the SAT**
- Probably the actual causal chain is...

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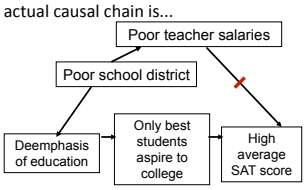

Correlation ≠ Causation

- (Non obvious) Example #7
  - Many studies show that students who attend private schools (A) tend to do better in college (B) than students who attend public schools.
  - Does this mean that the extra expense of sending your child to private school pays off in better college performance (and better opportunities thereafter)? (i.e., that A➔B)?
- Why not? Which of the other two necessary conditions for a causal relationship is not met?
  - **Not that B➔A. Why not?**
  - **Could some other variable covary with attending private school? Like what?**
    - **Like greater parental ability and investment,**
    - **like a better home learning environment**

Correlation ≠ Causation

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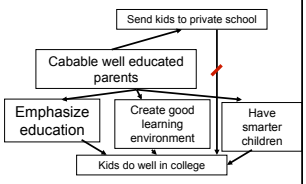
  - Does this mean that the extra expense of sending your child to private school pays off in better college performance (and better opportunities thereafter)? (i.e., that A➔B)?
- A likely causal chain is...
  - **Again, it could be that private school education is still better, causing better college performance**
  - **It's just that simply showing that A & B are related is not enough to show that A causes B**



How and when can one get from (cor)relation to causation?

- It is the use of a particular type of method (the "correlational" method, where many variables are uncontrolled) that gives rise to this ambiguity, not whether or not alternative causes are apparent
- Need to establish the relationship using methods which guarantee all three necessary conditions-- **the experimental method**
- **Moral: Simple correlations (associations, relationships) cannot ever justify strong (confident, certain, unambiguous) causal inference**

The "Jim twins"

- **Jim Lewis and Jim Springer, identical twins, first met at the age of 39. Lewis was a security. guard, Springer a deputy sheriff. Both married, and divorced, a woman named Linda—and remarried a Betty.**
- **Lewis had a son named "James Alan" and Springer a son named "James Allan"—and both shared a taste for Miller Lite and enjoyed watching Nascar.**
- **Both named their dogs "Troy"**
- **Both smoked and chewed their fingernails to the nub.**
- **Both drove Chevrolets**
- **Both had carpentry workshops in their basements and constructed white circular benches around tress in their yard**

"Patricia Ann Campbell's"

- **Both were born on same day: March 13, 1941**
- **Both of their fathers were known as: Robert Campbell**
- **Both were married in 1959 with military men, within 11 days of each other**
- **Both had two children aged 21 and 19**
- **Both liked oil paintings**
- **Both had worked as book-keepers and both had studied cosmetics**

- **Have you ever had the uncanny experience of listening to the radio, when you are startled to hear the vary song that you had just been thinking of?**
  - **Have you ever been thinking of a song that didn't then appear on the radio?**
  - **Have you ever heard a song on the radio that you hadn't just been thinking of?**
- **Have you ever had a dream that coincided with, or even predicted, an event that actually occurred?**
  - **Have you ever dreamt about an event that didn't actually occur?**
  - **Have any events ever occurred that you hadn't previously dreamt about?**

Causal Heuristics

- The Insight Fallacy
  - To understand something isn't necessarily to change it
  - "It is naïve to expect that, by telling people what we think we see they are doing, we will enable them to stop doing it." – R. D. Laing
  - **Once we can understand a problem, it will automatically solve the problem. Insight alone invariably produces useful change.**

Benefits of Experiments

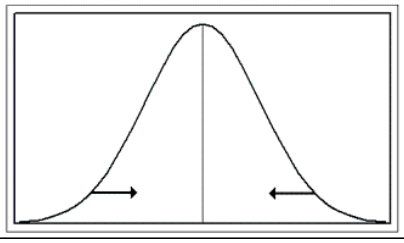
1. **Experiments allow for inferences regarding causality.**
   - **If your results are significant, you can say that the IV *caused* changes in the DV.**
2. **Experiments facilitate theory testing**
   - **If a theory says X causes Y, you can test if X actually causes Y.**
3. **Experiments can test for interactions between variables.**
   - **Do red and yellow make orange?**

Limitations of Experiments

1. **Experiments have low generalizability.**
2. **A researcher can test only a few variables at a time in an experiment.**
3. **Sometimes experiments are very difficult or impossible to do.**
4. **A researcher must already know quite a bit about the phenomenon to design a good experiment.**
5. **Experiments can be relatively expensive.**

Key Components of Experimental Design: Internal Validity

- **Some Threats to Internal validity**
  - Regression
    - Phenomenon that if a variable is extreme on its first measurement, it will tend to be closer to the average on its second measurement (extreme values can happen due to random factors)



Self-Fulfilling Prophecies

- Word, Zanna, & Cooper (1974)
  - Experiment 1
    - White participants played the part of an interviewer
    - Interviewed an applicant - either a White or Black confederate
    - Results showed that the Black applicant received:
      - **Less immediacy**
      - **Higher rates of speech errors**
      - **Shorter interview times**

Self-Fulfilling Prophecies

- Word, Zanna, & Cooper (1974)
  - Experiment 2
    - White participants were interviewed by a confederate interviewer
    - White applicants received behaviors (treated like) that were similar to those given to either the Black or White applicants from Exp. 1
    - Results showed that those who were treated like the Black job applicants were treated in Exp. 1:
      - **Performed less adequately**
      - **Were more nervous**
      - **Did worse on the interview**