Research Methods (HDFS 3390),
Alan Reifman, Texas Tech University
Causation/Experimentation

How does one thing affect something else?

- Does consistent parenting lead to healthy child development?
- Does peer pressure lead teenagers to begin substance use?
- Does smoking cause lung cancer?
- Does driving a car with gasoline fuel cause global warming?
- Does "beer, beer [make] you want to cheer [?] Or: It's cheer, cheer, cheer that makes you want a beer" (link)

Why Study Causality?

Faulty causal analysis can lead to useless advice

For example, couples who resolve conflicts through compromise tend to report high relationship satisfaction (link).

What comes first?

Compromise causes better satisfaction
(e.g., compromising defuses tension)

OR

Satisfaction causes compromise
(e.g., satisfied partners motivated to maintain harmony)

If second scenario is more powerful, then teaching couples to compromise will be of limited usefulness

CORRELATION

(BY ITSELF)

DOES NOT PROVE CAUSALITY

In fact, it's amazing the pairs of variables that correlate almost perfectly with each other (apparently) just by chance

Correlation is necessary for causality, but must have two other elements:

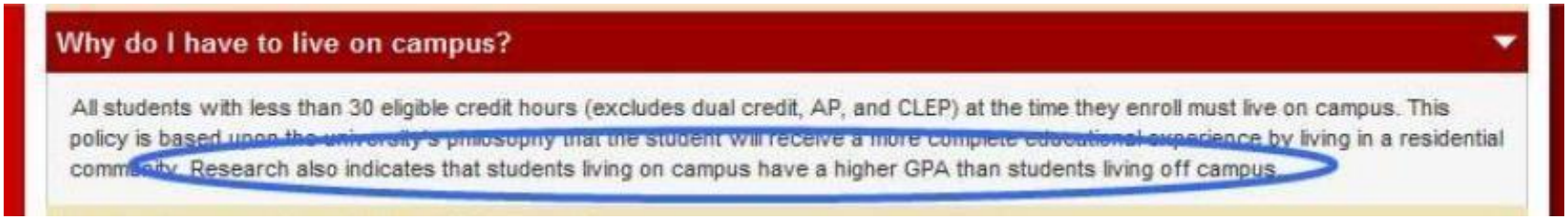
- Time ordering: Cause takes place before effect (e.g., taking aspirin comes before headache relief)
- Ruling out of "third variables"

Hypothetical example: Watching a lot of television as a teen (A) is correlated negatively with SAT Verbal scores (B). Three possible explanations exist:

A → B	TELEVISION CAUSES LOW VERBAL ABILITY (Many television shows do not expose viewer to challenging vocabulary, compared to books)
B → A	LOW VERBAL ABILITY CAUSES TV WATCHING (People with lower verbal ability might prefer to spend free time watching TV than reading books)
C → A, C → B	LACK OF CHILDHOOD READING EXPERIENCE (A THIRD VARIABLE "C") CAUSES BOTH HEAVY TV VIEWING AS A TEEN AND LOW SAT SCORES

Research Findings that Raise Questions of Causality...

- **Kids who attend schools in areas with high air pollution tend to show poorer academic performance (May 2011).**
- **Facebook use negatively correlated with college students' GPAs (this April 2009 article does a good job discussing correlation and causality).**
- **Texas Tech students who live on campus have higher GPA's than off-campus residents.**



- **Women with breast implants have a higher than usual suicide rate (August 2007).**
- **Going back 400,000 years, global temperatures and carbon dioxide (CO_2) concentrations have shown a virtually perfect positive correlation. If a *CO_2 → temperature* causal sequence exists, that would seem to call for actions to reduce CO_2.**
- **States with high gun-ownership rates also have high suicide rates (see Chart 4), plus another finding.**
- **Does the acne medication Accutane possibly contribute to teen suicide?**
- **Cities with high listenership of country music have high suicide rates.**
- **A piece of sports speculation: Does good team "chemistry" cause winning or does winning cause good chemistry?**

In-Class Activity

Each group gets a scenario, based on an actual research finding. For your scenario:

- **Try to develop a logical argument for A causing B.**
- **Try to develop a logical argument for B causing A.**
- **Is there a third variable C that might cause both A and B?**

1. **Being allowed by your parents to see R-rated movies (A) correlated with greater likelihood of kids taking up smoking (B) (research finding).**
2. **Having a TV set in the bedroom (A) correlated with couples having lower frequency of sexual activity (B) (research finding).**
3. **Adolescents' watching of professional wrestling (A) correlated with fighting during dates and elsewhere (B) (research finding).**
4. **Listening to certain types of sexual lyrics (A) correlated with teen sexual activity (B) (research finding).**
5. **Alcohol consumption (A) correlated with violent behavior (B) (research findings).**

A Song on Correlation and Causality Before We Move On...

Correlation

Lyrics by Alan Reifman
(May be sung to "Revolution," John Lennon)

You say you've got a correlation, well you know,
It says nothing about cause,
You've got to do experimentation, well you know,
To fulfill science's laws,

With a correlation between B and A,
Causal direction could go either way,

A correlation cannot be,
Airtight!
Airtight!!
Airtight!!!

You say you've got a correlation, well you know,
A and B are only linked,
You need further investigation, well you know,
To show the pathway that you think,

There's another option, and this is key,
There could be a third variable called C,

A correlation cannot be,
Airtight!
Airtight!!
Airtight!!!

EXPERIMENTATION

The Way to Show that "A" Causes "B“

Previous Example: ***Does Alcohol Consumption (A) Cause Violent Behavior (B)?***

- **CORRELATION: Greater alcohol consumption goes with greater violence.**
- **TIME-ORDERING: Have to make sure that alcohol consumption (A) comes before violent behavior (B) (rule out the reverse order, B ⟶ A, that violent people have characteristics that make them consume alcohol).**
- **RULING OUT OF THIRD VARIABLES: Have to rule out the possibility that some third variable (C) such as genes or risk-taking propensity causes <u>both</u> alcohol consumption (A) and violent behavior (B).**

Experiment to See if Alcohol Causes Violence

- **Obtain sample, often college students, but could be representative sample**
- **Take charge of subjects' exposure to the "cause" variable, also known as "INDEPENDENT VARIABLE," here alcohol consumption. You may decide to have three levels of alcohol intake:**

No Alcohol (non-alcohol beer) – "control group" or "placebo"	**Low Alcohol Beer – "experimental group"**	**High Alcohol Beer— "experimental group"**
Can have as many groups as you'd like (but at least one experimental and one control group)		

- **Assign subjects to the three groups at random – known as "RANDOM ASSIGNMENT" (also known as "RANDOMIZATION"). Random assignment ensures that any pre-existing "C" factors, such as genes or risk-taking propensity, are equally distributed throughout the three groups. This ELIMINATES the "third variable" problem. The only way the three groups will differ is in how much alcohol they're getting; everything is held constant, except for the crucial causal factor (alcohol).**
- **Article illustrating effectiveness of random assignment in creating groups with virtually equal characteristics before exposure to different program conditions (independent variable):**
  - **Franko, D. L., et al. (2005). Food, Mood, and Attitude: Reducing risk for eating disorders in college women. *Health Psychology, 24*, 567–578. (See in Blackboard Readings)**
- **Important to distinguish between "random selection" (how you get your participants), and "random assignment" (what you do with them once you've gotten them).**

Experimental Procedures (Continued)

- **After beverage administration, put subjects in situation where they could act violently, such as a game where they can deliver electric shocks to opponent. The "effect" variable (intensity of shocks in this case) is called the "DEPENDENT VARIABLE." The time-order problem is taken care of, because you've seen to it that alcohol consumption comes before the aggression.**
- **If subjects give more shock the higher the alcohol content they received, we can conclude that alcohol consumption CAUSES violent behavior. Note, however, that in order to regulate the situation to allow causal inference, the situation had to be made relatively artificial.**

NOTE: Any one experiment can only test a single causal direction. If we wanted to test if involvement in violence caused people to drink, we'd have to conduct another experiment. How could we test whether violence causes drinking?

Two Memory Aids: RAIDER and the Five E's

Randomly
Assign to conditions of
Independent variable, then observe on
Dependent variable, for
Experimental
Research

The 5 E's: Everything Equal Except Essential Element

Idea that experimental and control groups should be treated *as identically as possible* (amount of time spent with them, amount of attention they receive, equal belief in what they're getting; adapted from Eysenck, 1995), except for the *one crucial ingredient* of the treatment. Examples...

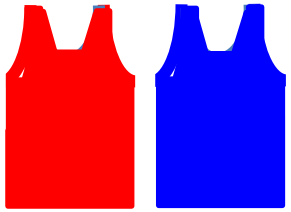
In acupuncture study, both groups had needles inserted, but experimental group had them inserted in proper acupuncture areas of body, whereas control group had needles inserted in areas not thought to be effective (further information on acupuncture).

Also, a denicotinized cigarette has been developed, so if you wanted to test the effect of nicotine ingestion on mental concentration, you could have both experimental and control groups smoke cigarettes in the lab, with the experimental group getting real cigarettes (with nicotine) and the control group getting placebic cigarettes (without nicotine).

Real-World Experiments

Chewing gum while learning math improves later test-score performance (April 2009)

From the old Fox Sports show "Sport Science," here's an illustrative single-subject design to study the effects of two different types of distraction (mainly visual; mainly audio), plus a control condition, on free-throw accuracy (Part I and Part II). This is obviously just a small demonstration for TV. How could this experiment be improved if we really wanted to study this matter?



Wearing red sports uniforms (as opposed to blue) is associated *causally* with winning. Study takes advantage of fact that in certain Olympic sports (e.g., boxing, wrestling), the determination of who wears red and who wears blue in a match is done *randomly*.

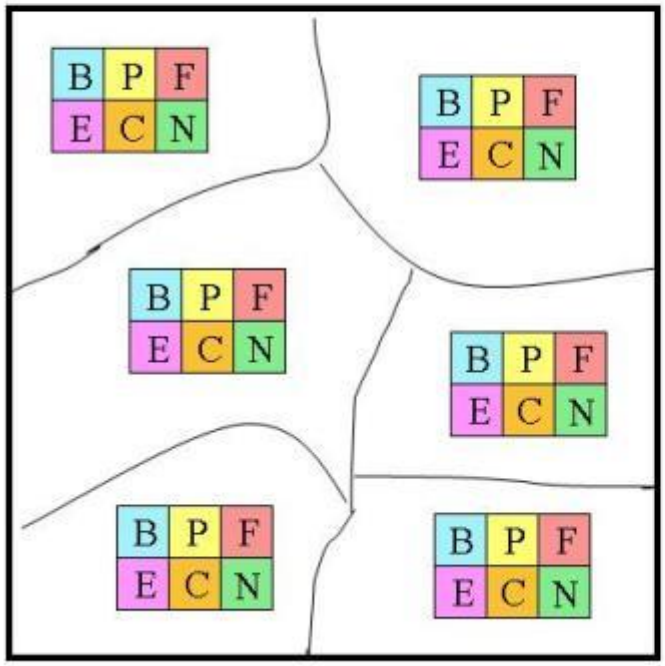
Returning a lost wallet (next slide)

What kind of enclosed photo increases the likelihood someone will return a lost wallet?

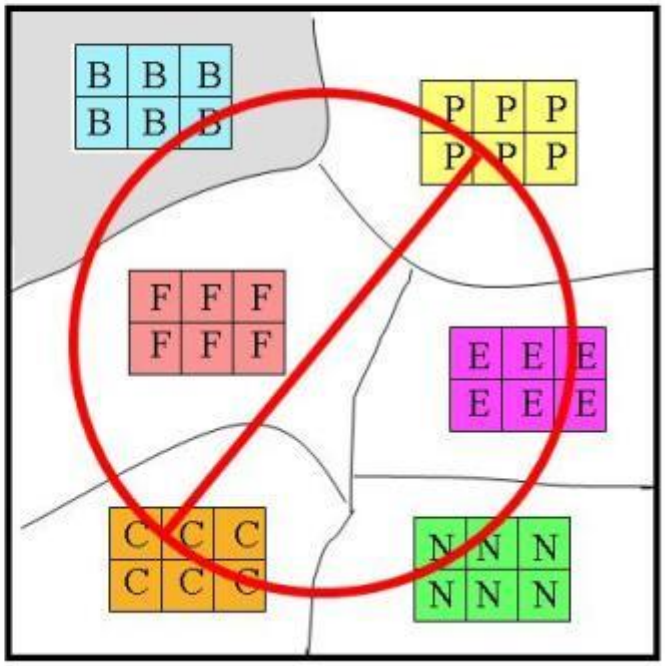
- **Type of wallet is the _____ variable (independent or dependent?)**
- **Returning/not returning the wallet is the _____ variable (independent or dependent?)**

Each wallet had one of the following: picture of baby (B), picture of puppy (P), picture of family (F), picture of elderly couple (E), charity papers (C), or nothing (N).

The investigators (presumably) spread a mix of wallet types in each neighborhood.



One would avoid "confounding" wallet type and neighborhood, or else we can't tell if return rates are due to picture-type or neighborhood.



The major research methods tend to have strengths, as well as weaknesses.		Ability to Infer Causality (INTERNAL VALIDITY)	
		Low	High
Ability to Represent Real-Life Situations (EXTERNAL VALIDITY)	Low		EXPERIMENTS
	High	SURVEYS	This would be the ideal – strong in both areas

Internal Validity

Degree to which study permits conclusion that independent variable has caused differences in dependent variable.

Threats to Internal Validity

(Ones below primarily applicable in laboratory setting)

EXPERIMENTER BIAS – Similar to how a survey interviewer can possibly bias answers via tone of voice, eye contact, etc., a lab experimenter could subconsciously give cues (smiles, nods, etc.) that encourage behavior.

Example from student in Spring 2006 3390 class, from when she judged a school science fair: One contestant had two plants, one of which he had talked to and the other, not. Sure enough, the plant that was talked to had more robust growth. Ideally, the experimenter would take great pains to ensure that the two plants were treated as identically as possible, except for the talking (e.g., equal water, equal sunlight). If the experimenter gave better treatment to the talked-to plant in these other ways, that would be experimenter bias.

EXPERIMENTAL DEMAND (or DEMAND CHARACTERISTICS)
Hypothesis of experiment is apparent to subject, who then tries to comply.

Example: An aggression study by Berkowitz and LePage (1967) raises this issue (see photos presented by Dr. Reifman in class). Berkowitz, however, wrote 40 years later (12/21/07) that:"I can also say I have had too many aggression experiments fail for me to believe in the idea of subjects eager to confirm the researcher's hypothesis. But more generally, I've seen little evidence that many research participants are quick to grasp the experiment's true purpose and that they believe they are helping science (Orne's assumption) by acting to confirm the researcher's hypothesis."

Remedy: Double-Blind Procedure

Neither experimenter nor participant knows the hypothesis or what condition the participant is in. Multiple experimenters are used (in our alcohol-violence example, one experimenter prepares beverages and another oversees the shock game). Placebo represents a good imitation of experimental group(s), so participant doesn't know what condition he/she is in. Deception may be a further way to hide hypothesis from participant.

Double-blind procedures could be applied to the above plant example through the use of two experimenters. One would talk to the designated "experimental" (E) plant and do nothing else. Another experimenter, "blind" to which plant is being talked to and which one is the "control" (C) plant, would do the watering and tending to the plants; without knowing which plant was E and which C, it would seem unlikely the waterer would favor one plant or the other.

Test your reasoning: Is the acupuncture experiment described in an earlier slide double-blind?