

Bias and Error

Common Problems in Experiments and Studies

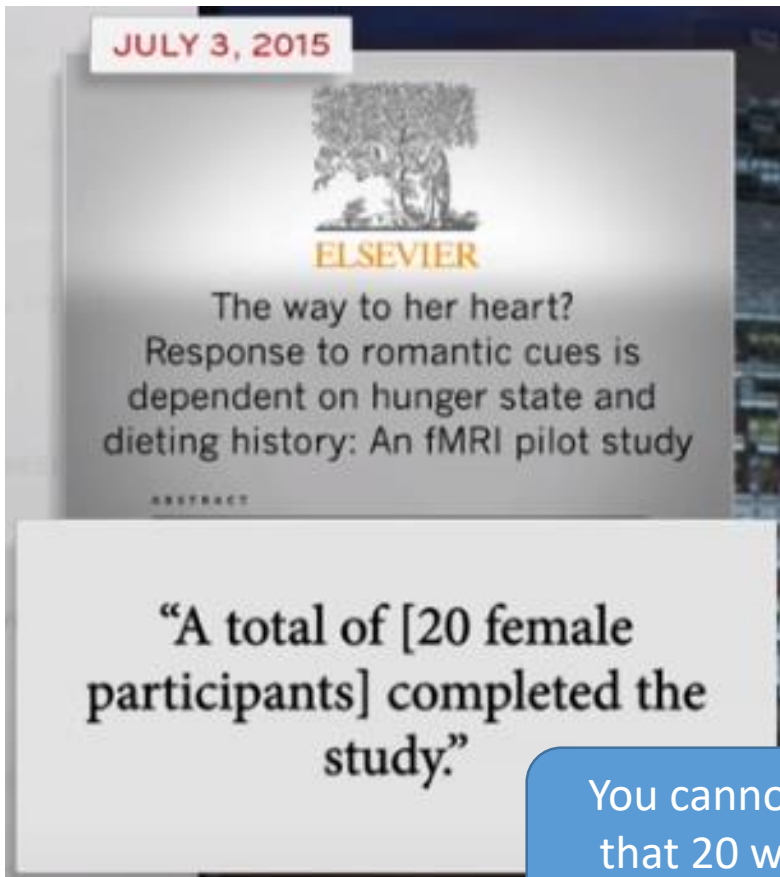
A. Errors in Conclusions

No Causation, but it is implied

If you have **low replication**, the LLN states that you could have variability and unreliable results.

If you have **no Random Assignment** and no control group, you don't know if spuriousness applies. By randomly assigning people into the groups, you can rule out other factors.

If you have **no Random Sampling**, your group may have Diversity problems which may skew your data.

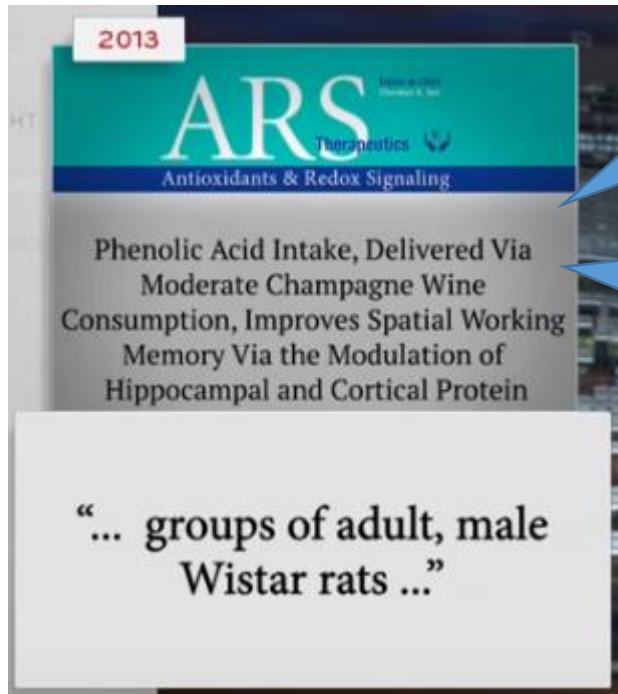


You cannot presume that 20 women can speak for all women.

A. Errors in Conclusions

STUDY: SOME HEALTH BENEFITS TO DRINKING CHAMPAGNE

A glass a week can delay dementia



Why didn't they mention the study was done on rats?

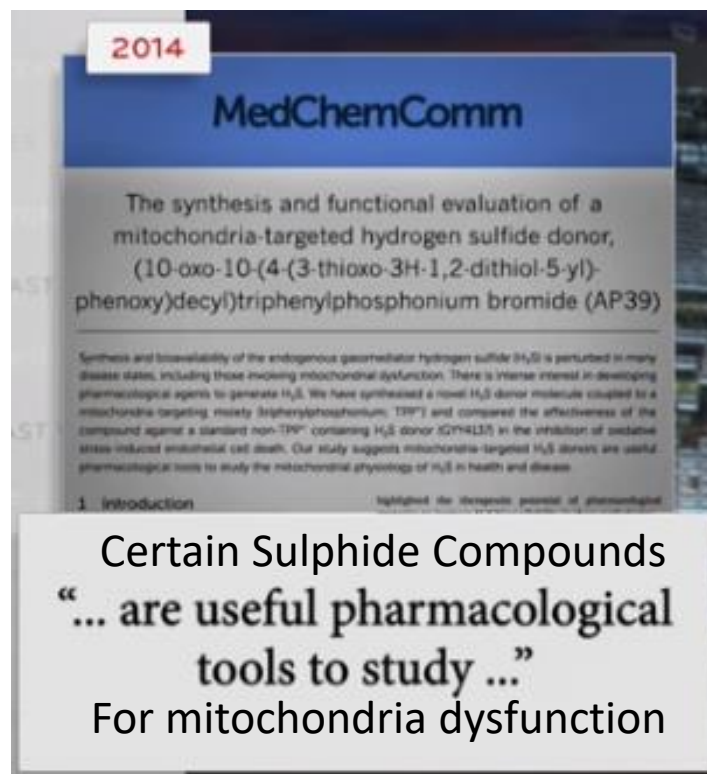
Sometimes rodent results match human, but sometimes they don't.

Lab rat studies are an early stage of research. More is needed.

Transferring Findings

The news media loves to take results from a limited, narrow study and extend them to other times, places and species.

This is not what the study concluded.



You can't fart away cancer. In case you were wondering.

THE SCIENCE NEWS CYCLE

JORGE CHAM © 2009

Start Here



Your Research

Conclusion: A is correlated with B ($p=0.56$), given C, assuming D and under E conditions.



...is translated by...

UNIVERSITY PR OFFICE (YES, YOU HAVE ONE)

FOR IMMEDIATE RELEASE:
SCIENTISTS FIND
POTENTIAL LINK
BETWEEN A AND B
(UNDER CERTAIN CONDITIONS).



...which is then
picked up by...

NEWS WIRE ORGANIZATIONS

A CAUSES B, SAY
SCIENTISTS.



...who are
read by ...

THE INTERNETS

Scientists out to kill us again.

POSTED BY RANDOM DUDE

Comments (377)

OMG! i kneew ittl!

WTH???????

...

...then noticed by...



We saw it on a Blog!

A causes B all the time
What will this mean for Obama?

BREAKING NEWS BREAKING NEWS BREA

...and caught
on ...

CNC Cable NEWS



4 LOCAL EYEWITLESS NEWS

WHAT YOU DON'T
KNOW ABOUT "A" ...
CAN KILL YOU!
MORE AT 11...



...eventually
making it to...



RESEARCH TOPICS GUARANTEED TO BE PICKED UP BY THE NEWS MEDIA

Chocolate! Anything that validates the public's wishful thinking that chocolate is secretly good for you is news *gold*.



A chocolate lover reacts to news that her chocolate addiction is making her smarter *and* saving the environment.

Unrealistic Sci-Fi Gadgets

Everyone is still waiting for their jet-packs, flying cars, and teleporters. Get on it, Science!



Engineers test latest invisibility cloak prototype.

JORGE CHAM © 2009

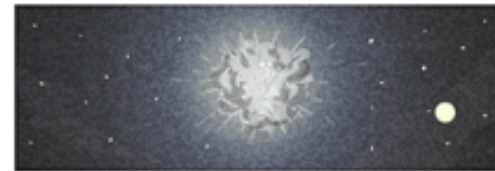
ROBOTS!! Everyone loves robots. In fact, news outlets are required by law to feature a robot story every 7 days.



Robotist demonstrates nose-picking robot, says will soon replace humans.

Experiments That Might Blow Up The World

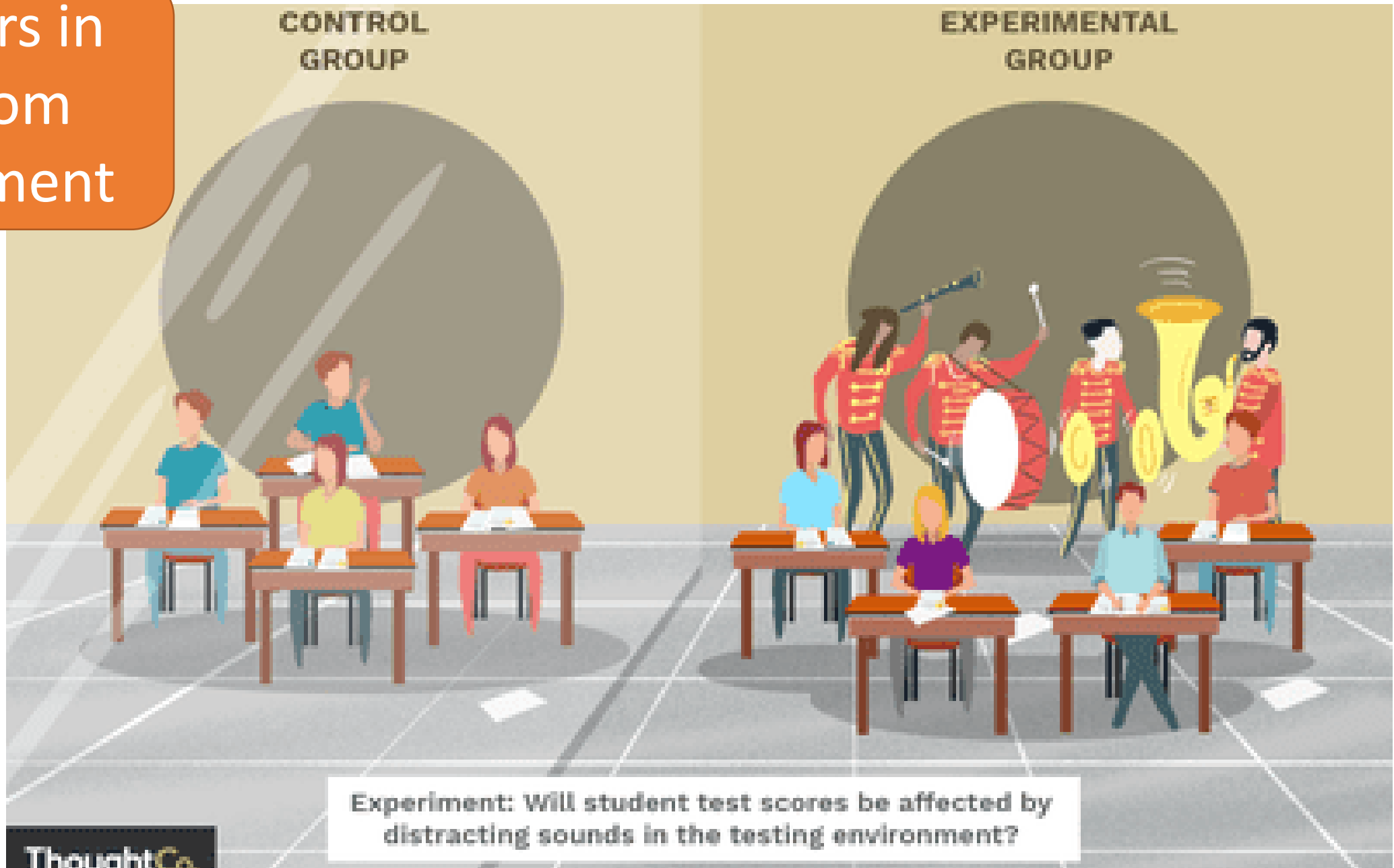
Nothing gets the crazies riled up like recreating conditions of the Big Bang in the only planet you have. Hope your math is right!



"Oops," say scientis-

WWW.PHDCOMICS.COM

B. Errors in Random Assignment



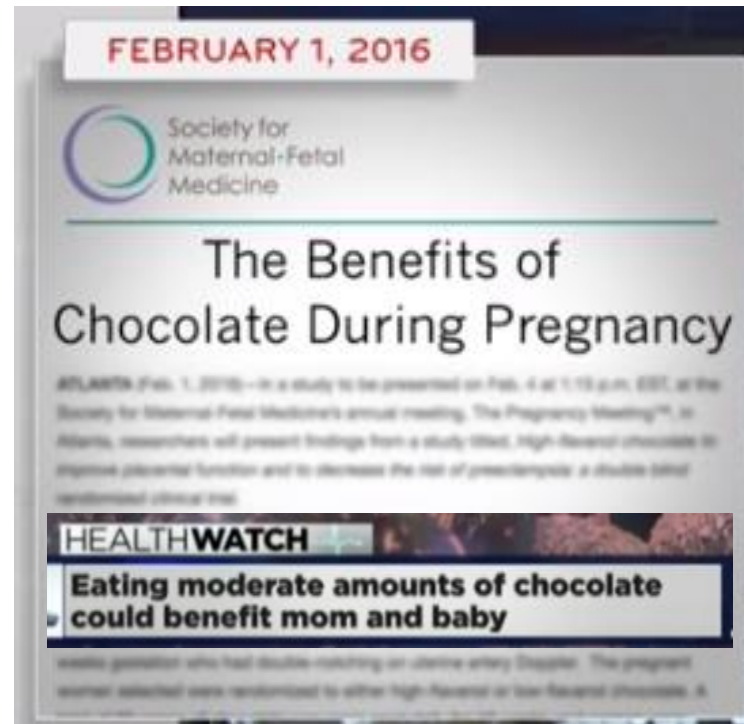
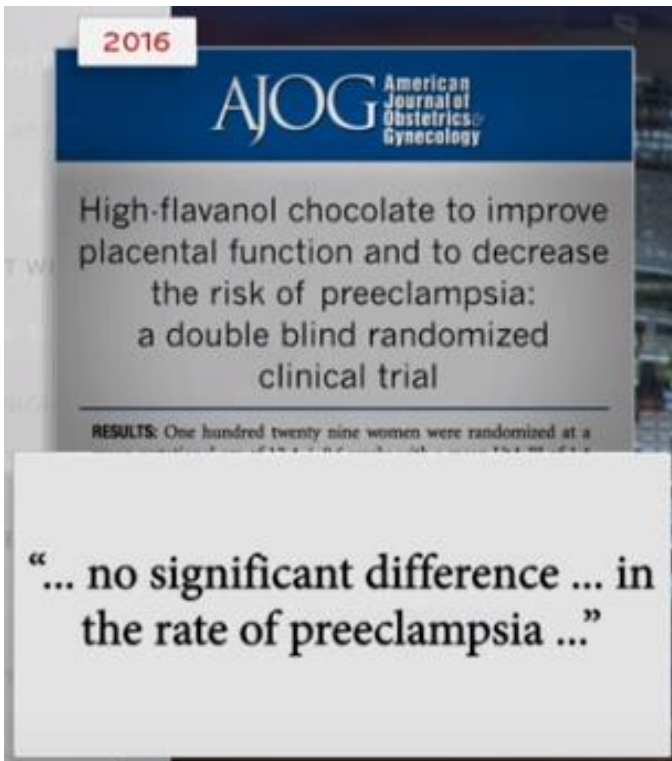
B. Errors in Random Assignment

Didn't account for Placebo Effect

Simply receiving treatment (a sugar pill or placebo) cures some people.

If causal, your group must have a control group that accounts for the placebo effect.

Your medication should outperform a placebo.



No control group of people who didn't eat chocolate.

B. Errors in Random Assignment

No Blinding

With Blinding, the **subject** doesn't know if they are in the control group, placebo group or the real group.

If you don't have blinding, the subject's expectations could change the outcome of the experiment.



B. Errors in Random Assignment



No Double Blinding

With Double Blinding, the **researcher** also doesn't know who is in each group. This avoids subtle things that the researcher might do to encourage one group over the other.

C. Sampling Errors

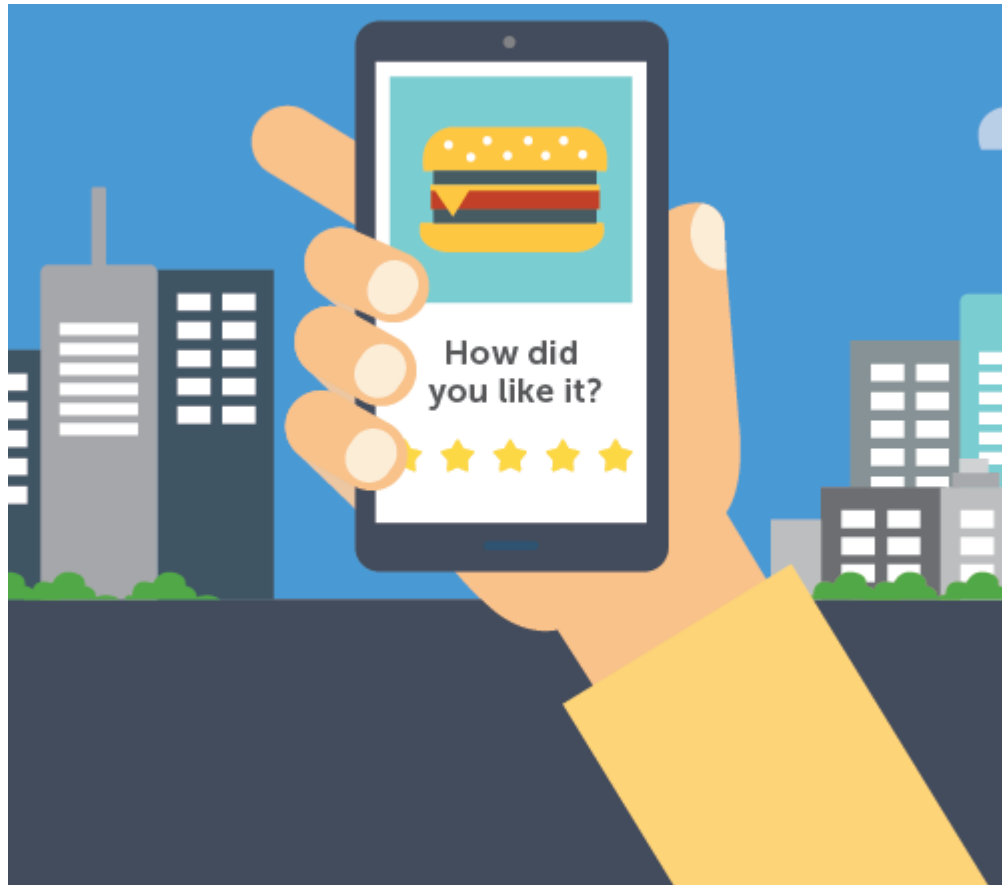
Convenience Sampling

Go to a location.
Ask whoever is
there.

The diversity of
your subjects is
limit to the people
present.



C. Sampling Errors



Self-Selection

Post your survey in a public location. People choose if they respond.

The people who respond will only be people who feel strongly about the issue. Not representative.

The Literary Digest

NEW YORK

OCTOBER 31, 1936

Topics of the day

LANDON, 1,293,669; ROOSEVELT, 972,897

Final Returns in The Digest's Poll of Ten Million Voters

Well, the great battle of the ballots in the Poll of ten million voters, scattered throughout the forty-eight States of the

Republican National Committee purchased THE LITERARY DIGEST?" And all types and varieties, including: "Have the Jews purchased

returned and let the people of the Nation draw their conclusions as to our accuracy. So far, we have been right in every Poll. Will we be right in the current Poll? That, as Mrs. Roosevelt said concerning the President's reelection, is in the 'lap of the gods.'

"We never make any claims before election but we respectfully refer you to the opinion of one of the most quoted citizens

- Landon would get 57% of the vote against Roosevelt's 43%
- Asked 1 out of 4 Americans.

C. Sampling Errors

Selection Bias

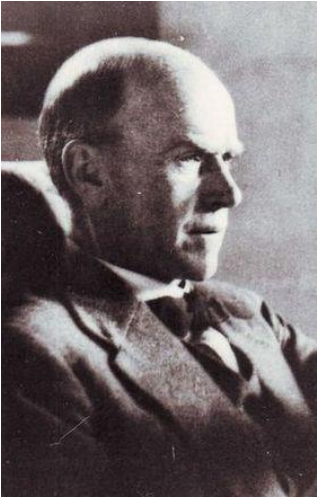
Essentially, these are diversity issues between your plan unit and problem unit.

The subjects not included in your study may have differing results than those you studied.

May include a Non-response bias. People who don't care enough to respond, may have an impact on the actual results.



D. Observation Errors



George Mayo observed workers in the Hawthorne General Electric Plant



Hawthorne Effect

The act of observing people changes their behaviour.

You need to try to compensate for this effect.

Sometimes done by hiding what researchers are actually observing from subjects with fake tasks

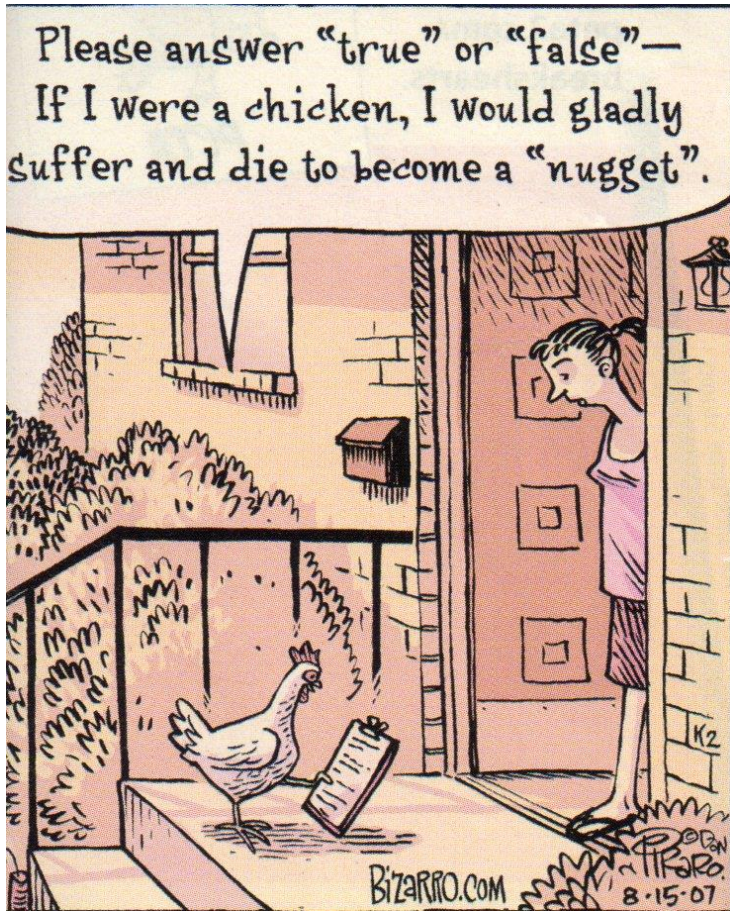
D. Observation Errors

Question Effects

Leading Questions may skew your results.
Double barreled questions are difficult to answer.
Sensitive questions may not be answered at all.
The multiple choice options may not have the answer the subject wants.



D. Observation Errors



Social Desirability Bias

People answer as they feel they should.

Respondents to surveys exercise more, read more and eat better than all other evidence suggests.

You need to be careful when you frame survey questions.

D. Observation Errors

Experimenter Mistakes

You calculate the average wrong.
You make a mistake in your probability calculation.
You miscount one of the subjects.



How many people are in this crowd?

It's not always easy to count.

E. Bought and Paid For

Bias Due to Funding

DEHYDRATION DANGER
RPT: DRIVING DEHYDRATED SAME AS DRIVING DRUNK

APRIL 20, 2015

NHS choices

Why you should drink (water) before you drive

“... a small trial of 12 men ...”

APRIL 20, 2015

NHS choices

Why you should drink (water) before you drive

“Data is only reported for 11 ...”

APRIL 20, 2015

NHS choices

Why you should drink (water) before you drive

“The study was ... funded by the European Hydration Institute.”

Coca-Cola

Gave them \$7 million

**RPT: GLASS OF RED WINE
EQUIVALENT TO HOUR OF GYM TIME**

HEALTH ALERT
SUGAR MAY FUEL GROWTH OF CANCER
STUDY SAYS WESTERN-STYLE DIET PARTLY TO BLAME



MIDNIGHT MEMORIES
STUDY: LATE-NIGHT SNACKS BAD FOR BRAIN

PIZZA IS MOST ADDICTIVE FOOD
FRENCH FRIES, CHOCOLATE CLOSE BEHIND

**DOGS DON'T LIKE HUGS &
CAN RAISE STRESS: STUDY**



RX FOR BETTER REST
LEFT-SIDE SLUMBER = IMPROVED MOOD