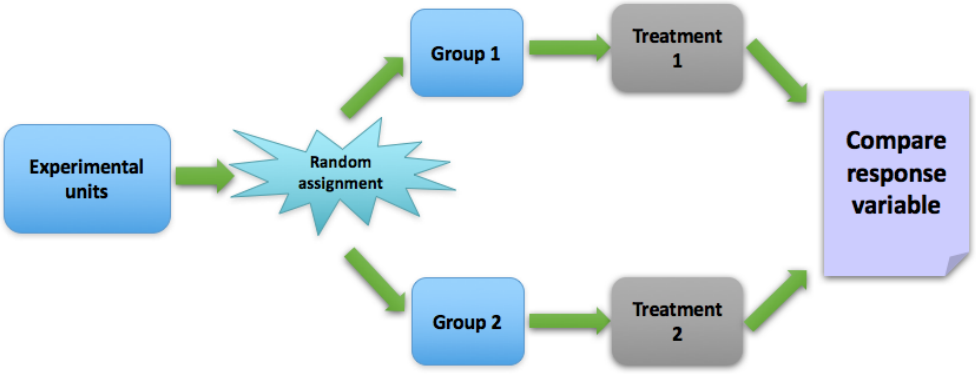
Completely Randomized Design
(pages 255-256)

A look back before we go forward

1. Comparison
2. Random Assignment
3. Control
4. Replication

In a **completely randomized design**, the experimental units are assigned to the treatments completely by chance.



Practice describing random assignment process using different methods

- Slips of paper
- Random number generator
- Table of random digits

Replication

Use enough subjects

Suppose there were only 6 subjects in the caffeine/pulse rate experiment? (2 of whom are regular coffee drinkers)

That would mean:

50% chance that the two caffeine drinkers in the same treatment group. Yikes!

- However if we had 60 subjects and 20 were coffee drinkers, there is a good chance that each control group would end up with a decent concentration of them.
- The more replication, the more balanced the treatment groups. :)

Note:

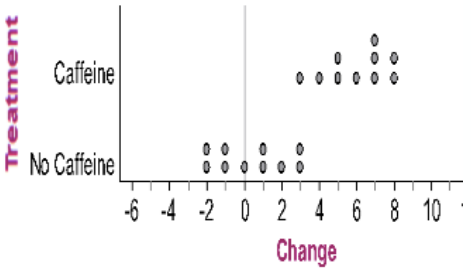
AP Bio and Chem use an alternative meaning of replication:

- When an experiment is independently conducted in a different location by different investigators

Control — Keep other variables constant

Preventing confounding:

If one treatment group was given regular Coke (which has sugar) and the other treatment group was given caffeine free Diet Coke (which has no sugar), then sugar and caffeine would be confounded.

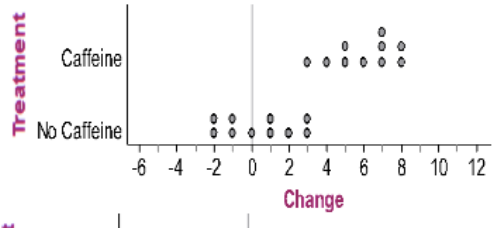


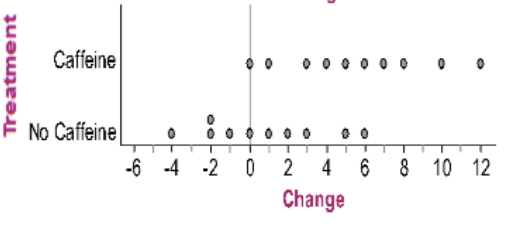
Solution: *keep sugar constant.*

Reducing variability in the response variable:

If we let subjects in both groups drink any amount of soda they want, the changes in pulse rates will be more variable than if we made sure each subject drank the same amount of soda.

Less ability to see difference in effect.



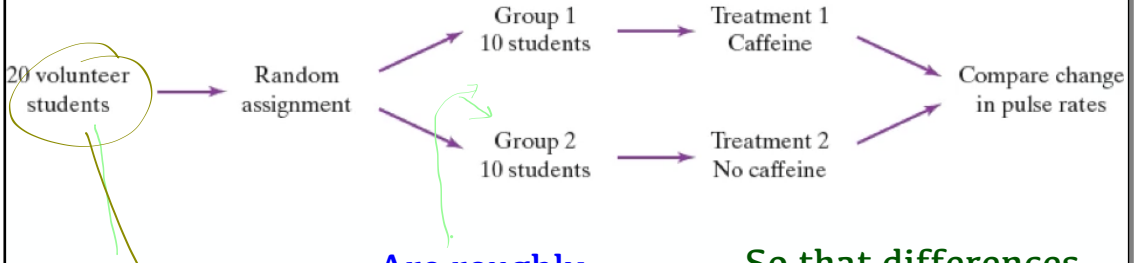


Look back at caffeine - pulse rate experment

Designing Experiments: Random Assignment, Control and Replicatior

(pages 251-)

handout



Any potential confounding variables when we start out…

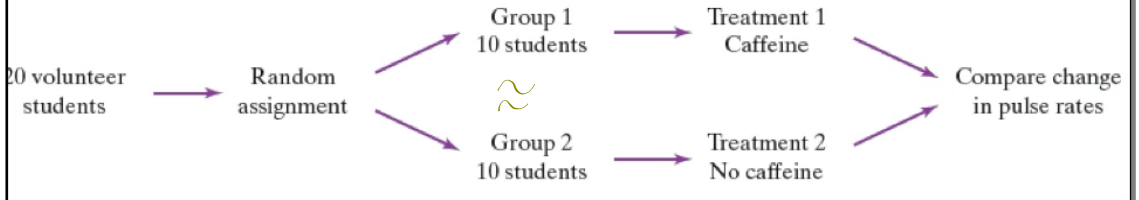
Are roughly ~~equally~~ distributed equally to the two groups….

So that differences in resulsts are due to the treatments and not confounding variables.

CAUSATION !

We can't say that *any* difference in average response between treatment groups must be caused by the treatments because there would likely be some difference just because the random assignment is unlikely to produce two groups that are exactly equivalent.

It's tempting to skip the step "Group 1" and "Group 2".



Why needed:

At Group 1 and Group 2 the groups are roughly equivalent (because of random assignment).

Add 2

It's only when we get to Treatment 1 and Treatment 2 do the groups become different

If there is a significant difference in the pulse rates at the end of the experiment, then we have strong evidence that the difference was caused by the caffeine.

Learning Target Today:

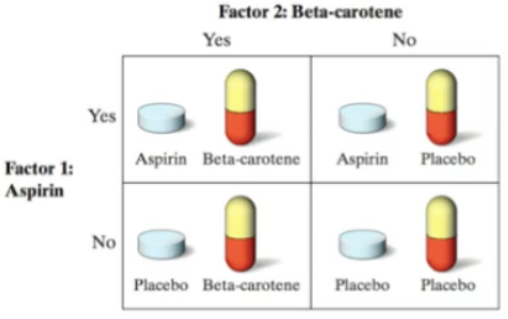
Describe a completely randomized design for an experiment.

Putting it all together

The Physician's Health Study

read together

Does regularly taking aspirin help protect people against heart attacks? The Physicians' Health Study was a medical experiment that helped answer this question. In fact, the Physicians' Health Study looked at the effects of two drugs: aspirin and beta-carotene. Researchers wondered if beta-carotene would help prevent some forms of cancer. The subjects in this experiment were 21,996 male physicians. There were two explanatory variables (factors), each having two levels: aspirin (yes or no) and beta-carotene (yes or no). Combinations of the levels of these factors form the four treatments shown in the diagram. One-fourth of the subjects were assigned at random to each of these treatments.



On odd-numbered days, the subjects took either a tablet that contained aspirin or a placebo that looked and tasted like the aspirin but had no active ingredient. On even-numbered days, they took either a capsule containing beta-carotene or a placebo. There were several response variables—the study looked for heart attacks, several kinds of cancer, and other medical outcomes. After several years, 239 of the placebo group but only 139 of the aspirin group had suffered heart attacks. This difference is large enough to give good evidence that taking aspirin does reduce heart attacks. It did not appear, however, that beta-carotene had any effect on preventing cancer.

Answer the 4 questions in your group

a) Explain how this experiment used comparison.

b) Explain the purpose of randomly assigning the physicians to the four treatments.

c) Name two variables that were controlled in this experiment and why it was beneficial to control these variables.

d) Explain how this experiment used replication. What was the purpose of replication in this context?

The Hawthorne Effect

A Harvard researcher was once conducting some experiments at Western Electric's Hawthorne Works to see if certain changes in conditions would improve worker productivity. In one part of the study, a group of workers was provided additional lighting and was compared to a group with no additional lighting. The group with additional lighting showed significant improvements in worker productivity.

(a) Explain why it isn't reasonable to conclude that the additional lighting is effective for increasing worker productivity based on this study.

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It is possible that the group who received the add'l lighting improved because they knew they were being measured, not because of the lighting.

NOTE This phenomenon is now commonly known as the HAWthorne effect, which describes how worker productivity can increase simply because workers know they are being measured.

(b) To test the effectiveness of the additional lighting, you recruit 20 similar companies that have agreed to have employees participate in an experiment. Write a few sentences describing a completely randomized design for this experiment.

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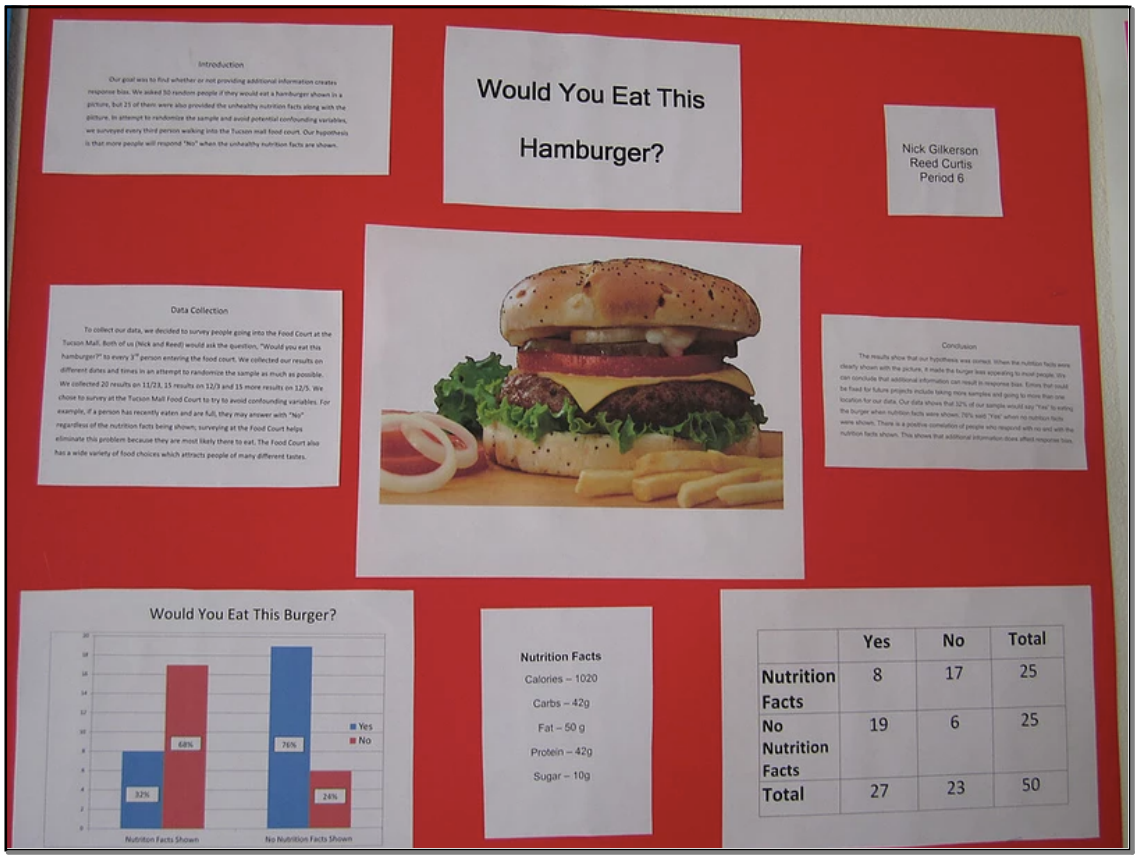
(1) Number companies from 1 to 20.
(2) Use a random number generator to produce 10 different random integers from 1 to 20 and and increase the lighting of the companies for these #'s.
(3) Leave lighting as is for the remaining 10 companies.
(4) Compare the increase in worker productivity btwn groups.

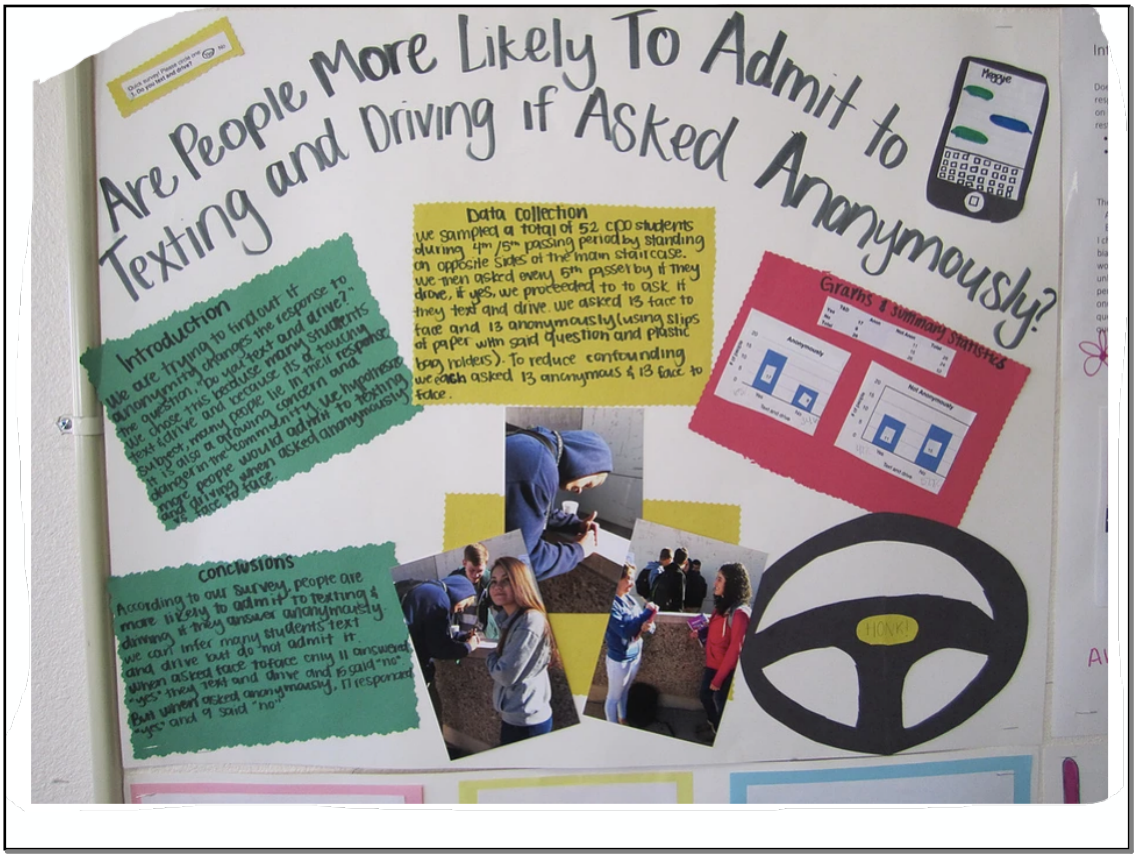
Response Bias Project

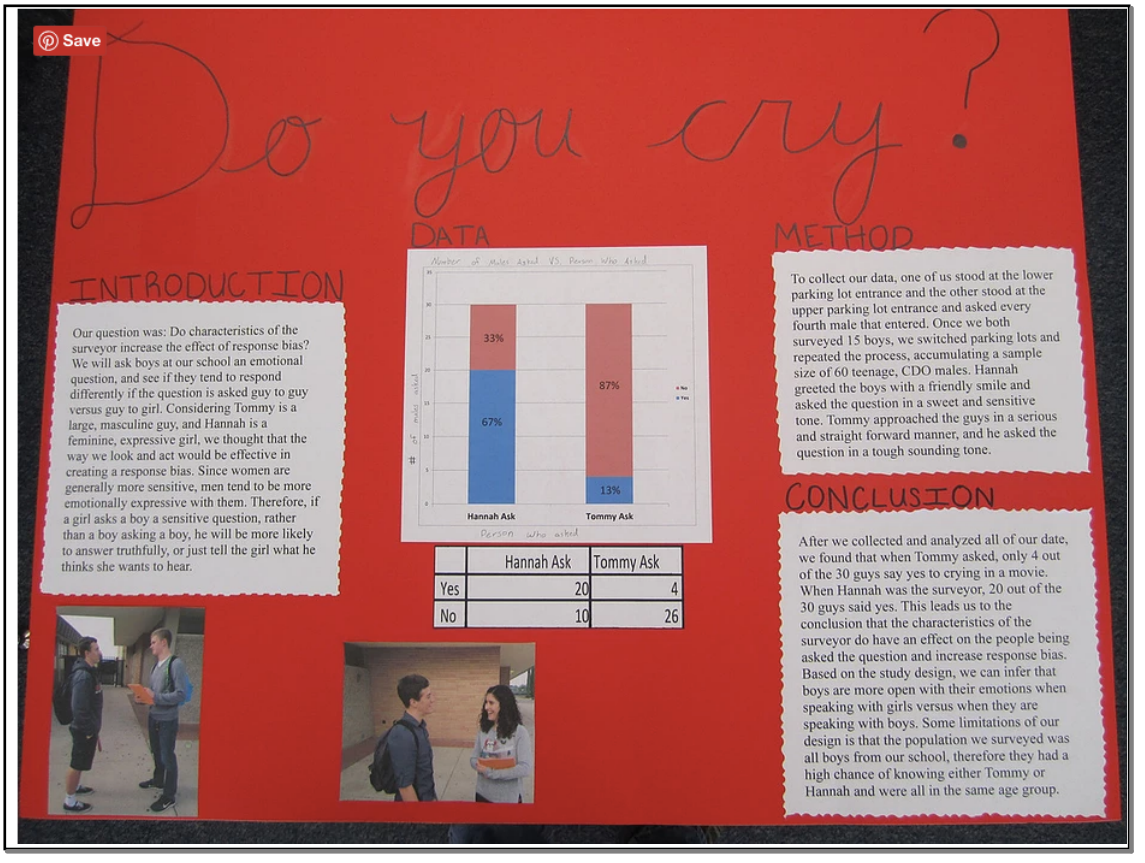
A project where you will try to create response bias.

Would your decision to eat a delicious hamburger change if you knew the nutrition information?

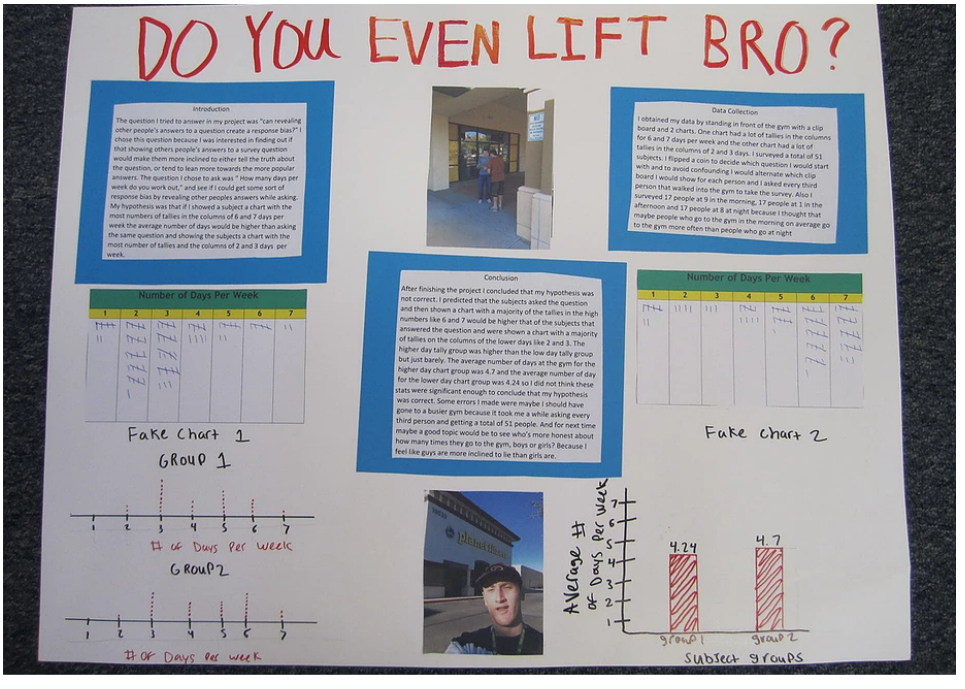


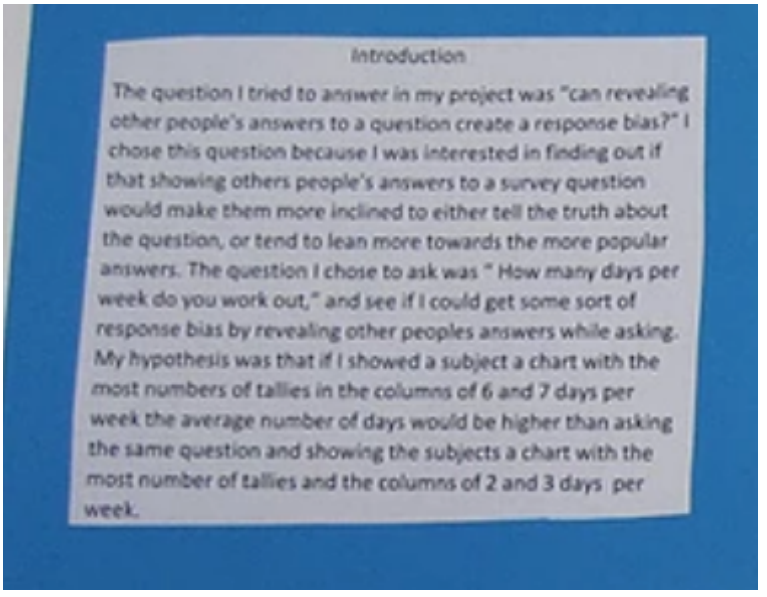
Would you admit to texting and driving in a personal interview…or if a survey was anonymous?


Are People More Likely To Admit to Texting and Driving if Asked Anonymously?
Introduction
We are trying to find out if anonymity changes the response to the question "do you text and drive?" We chose this because many students text & drive, and because its a touchy subject, many people lie in their response. It is also a growing concern and danger in the community. We hypothesize more people would admit to texting and driving when asked anonymously vs face to face.
Data Collection
We sampled a total of 52 CDO students during 4th/5th passing period by standing on opposite sides of the main staircase. We then asked every 5th passer by if they drive, if yes, we proceeded to to ask if they text and drive. We asked 13 face to face and 13 anonymously (using slips of paper with said question and plastic bag holders). To reduce confounding we each asked 13 anonymous & 13 face to face.
Graphs & Summary Statistics
Conclusions
According to our survey, people are more likely to admit to texting & driving if they answer anonymously. We can't infer many students text and drive but do not admit it. When asked face to face only 11 answered "yes" they text and drive and 15 said "no". But when asked anonymously, 17 responded "yes" and 9 said "no".
HONK!


Save
Do you cry?
INTRODUCTION
Our question was: Do characteristics of the surveyor increase the effect of response bias? We will ask boys at our school an emotional question, and see if they tend to respond differently if the question is asked guy to guy versus guy to girl. Considering Tommy is a large, masculine guy, and Hannah is a feminine, expressive girl, we thought that the way we look and act would be effective in creating a response bias. Since women are generally more sensitive, men tend to be more emotionally expressive with them. Therefore, if a girl asks a boy a sensitive question, rather than a boy asking a boy, he will be more likely to answer truthfully, or just tell the girl what he thinks she wants to hear.
DATA
Number of Males Asked VS. Person Who Asked
33%
67%
87%
13%
Hannah Ask
Tommy Ask
Person who asked
# of males asked
No
Yes
Hannah Ask | Tommy Ask
Yes | 20 | 4
No | 10 | 26
METHOD
To collect our data, one of us stood at the lower parking lot entrance and the other stood at the upper parking lot entrance and asked every fourth male that entered. Once we both surveyed 15 boys, we switched parking lots and repeated the process, accumulating a sample size of 60 teenage, CDO males. Hannah greeted the boys with a friendly smile and asked the question in a sweet and sensitive tone. Tommy approached the guys in a serious and straight forward manner, and he asked the question in a tough sounding tone.
CONCLUSION
After we collected and analyzed all of our date, we found that when Tommy asked, only 4 out of the 30 guys say yes to crying in a movie. When Hannah was the surveyor, 20 out of the 30 guys said yes. This leads us to the conclusion that the characteristics of the surveyor do have an effect on the people being asked the question and increase response bias. Based on the study design, we can infer that boys are more open with their emotions when speaking with girls versus when they are speaking with boys. Some limitations of our design is that the population we surveyed was all boys from our school, therefore they had a high chance of knowing either Tommy or Hannah and were all in the same age group.


Save
ARE YOU AFRAID OF THE DARK?
Introduction
Our topic is asking people if they are afraid of the dark. We will be testing if the wording of a question can create response bias. To test this one person will ask 30 randomly selected adults the question: "Do you still have the childish fear of the dark?" while the other person will ask another 30 randomly selected adults: "Do you have a fear of the dark?" We want to see if the way we word the question has any effect on the response.
We predict that less people will be willing to admit to a fear of the dark to the question that labels the fear as "childish". We think this because in today's culture, things that are labeled as childish are more likely to be embarrassing to some people.
Do You Have a Fear of the Dark?
Do You have the Childish Fear of the Dark?
Graph
Data Collection
To obtain the 60 people for our sample we will go to the Tucson Mall and each of us will stand at a different exit. Then we will ask every third adult leaving, the respective question. By asking every third person we can eliminate any bias that would cause, and truly have a randomized sample.
Ciara will stand at one exit and alternating between questions, ask every third person: "Do you have a fear of the dark?" or "Do you still have the childish fear of the dark?" and record the responses until she has asked 30 people. At the same time, Jessica will stand at a different exit and alternating between questions, ask every third person: "Do you have a fear of the dark?" or "Do you still have the childish fear of the dark?" and record the responses until she has asked 30 people. To avoid any biases we will not let anyone see how previous people have responded to the question nor will we give any ideas to the subjects to how we would respond. When we have gathered all of the data we will compare numbers to see which question got more yes's and no's. If someone chooses to not participate then we will skip them and just ask the next third person.
Conclusion
From this study we can conclude that for this setting, the wording of a question can indeed create response bias. According to our results, considerably less people were willing to admit to having a fear of the dark if we labeled that fear as childish. And by considerably less we mean about 20% less! Based off of this study we could infer that how you word a question can affect the way someone will answer. Although that may not always be the case. A possible error that may have occurred during our experiment is that a lot of people refused to stop to listen to our question, so that could have affected the results. Also, in the 60 people we asked a majority of them happened to be men so they might have not wanted to tell the truth if they really did have a fear. This too could have affected our results.
Results!
This graph shows the results of our experiment. It clearly shows how when people were asked if they had a "childish" fear of the dark they were more likely to say no. For the "fear of the dark" question, eleven out of the thirty (or about 37%) adults asked were willing to admit to a fear, but when it came to the "childish fear of the dark" question only five out of the thirty (or about 17%) adults asked were willing to admit to it.


DO YOU EVEN LIFT BRO?
Introduction
The question I tried to answer in my project was "can revealing other people's answers to a question create a response bias?" I chose this question because I was interested in finding out if that showing others people's answers to a survey question would make them more inclined to either tell the truth about the question, or tend to lean more towards the more popular answers. The question I chose to ask was " How many days per week do you work out," and see if I could get some sort of response bias by revealing other peoples answers while asking. My hypothesis was that if I showed a subject a chart with the most numbers of tallies in the columns of 6 and 7 days per week the average number of days would be higher than asking the same question and showing the subjects a chart with the most number of tallies and the columns of 2 and 3 days per week.
Data Collection
I obtained my data by standing in front of the gym with a clip board and 2 charts. One chart had a lot of tallies in the columns for 6 and 7 days per week and the other chart had a lot of tallies in the columns of 2 and 3 days. I surveyed a total of 51 subjects. I flipped a coin to decide which question I would start with and to avoid confounding I would alternate which clip board I would show for each person and I asked every third person that walked into the gym to take the survey. Also I surveyed 17 people at 9 in the morning, 17 people at 1 in the afternoon and 17 people at 8 at night because I thought that maybe people who go to the gym in the morning on average go to the gym more often than people who go at night
Conclusion
After finishing the project I concluded that my hypothesis was not correct. I predicted that the subjects asked the question and then shown a chart with a majority of the tallies in the high numbers like 6 and 7 would be higher that of the subjects that answered the question and were shown a chart with a majority of tallies on the columns of the lower days like 2 and 3. The higher day tally group was higher than the low day tally group but just barely. The average number of days at the gym for the higher day chart group was 4.7 and the average number of day for the lower day chart group was 4.24 so I did not think these stats were significant enough to conclude that my hypothesis was correct. Some errors I made were maybe I should have gone to a busier gym because it took me a while asking every third person and getting a total of 51 people. And for next time maybe a good topic would be to see who's more honest about how many times they go to the gym, boys or girls? Because I feel like guys are more inclined to lie than girls are.
Number of Days Per Week
1 2 3 4 5 6 7
Fake Chart 1
GROUP 1
# of Days Per Week
GROUP 2
# of Days Per week
Number of Days Per Week
1 2 3 4 5 6 7
Fake chart 2
Average # of Days per week
4.24
4.7
group 1
group 2
Subject groups



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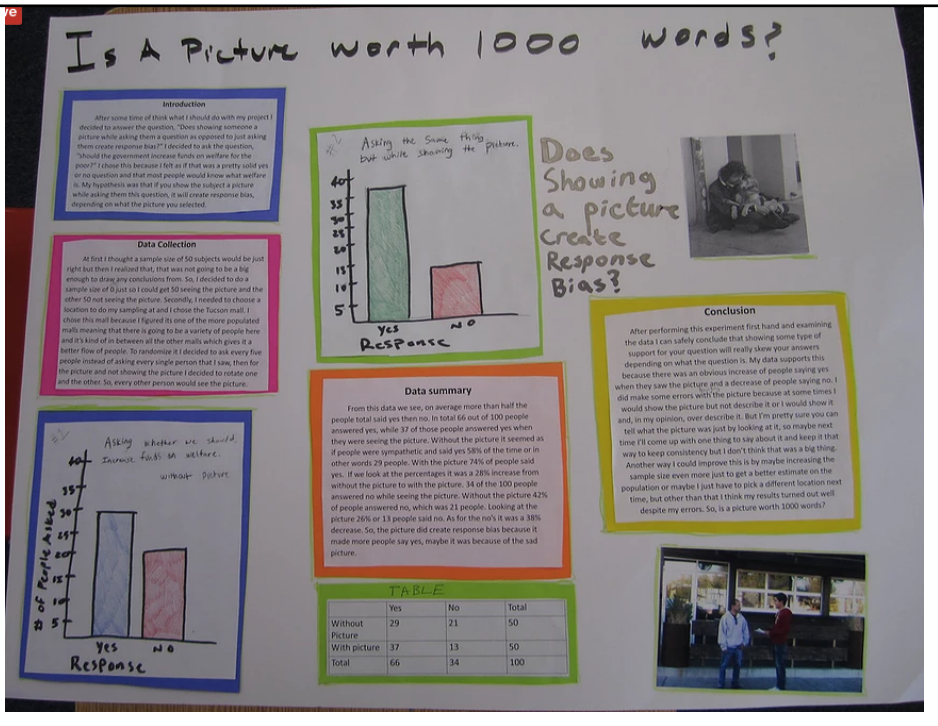

	Yes	No	Total
Without Picture	29	21	50
With picture	37	13	50
Total	66	34	100

4.2 ....55, 65, 67, 69