[notes for days 2 and 3]

Welcome [ap Statistics

Random Sampling

- All statistical sampling designs have in common the idea that

chance

NOT HUMAN CHOICE

is used to select the sample.

Randomize –
let chance do the choosing!

Randomization can protect you against

-factors that you know are in the data

-factors you are not even aware of

Randomizing makes sure that

on the average

the sample looks like the population.

Summary of Sampling Methods

- **Simple Random Sampling (SRS)**
  - every individual has an equal chance of being selected
  - every set of *n* individuals has an equal chance of being selected
  - **most basic & fundamental type of sampling!*

Describe how to select a SRS of 5 students from a group of 27:

- Assign each student a unique number from 1 – 27
- Use a RNG (on a calculator/computer) to generate 5 **UNIQUE** numbers from 1 – 27 (repeated numbers will be ignored).
- The 5 students who have their numbers drawn will…

OR

- Assign each student a unique number from 1 – 27
- Write the numbers 1 – 27 on slips of paper, and put them in a hat. Stir the slips to mix them.
- Without looking, draw 5 slips of paper from the hat **WITHOUT REPLACEMENT**.
- The 5 students who have their numbers drawn will…

Summary of Sampling Methods

- **Stratified Sampling**
  - divide population into strata (layers, subpopulations)
  - Strata are **homogenous**
  - take SRS from each strata
- **Cluster sampling**
  - divide population into clusters
  - Clusters are **heterogenous** (mixed)
  - Randomly select one (or more) cluster(s)
  - Take a CENSUS within cluster(s)

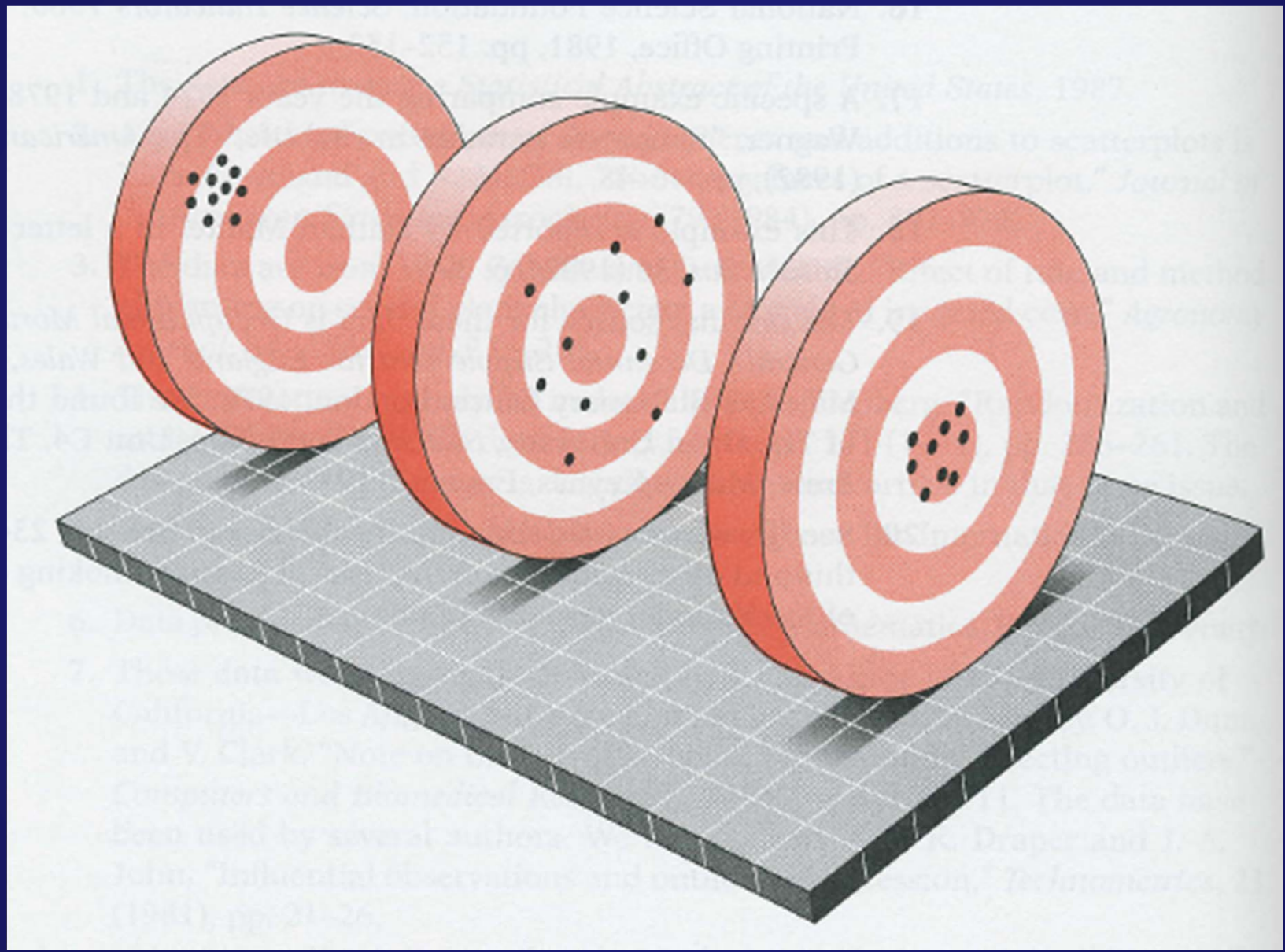
Summary of Sampling Methods

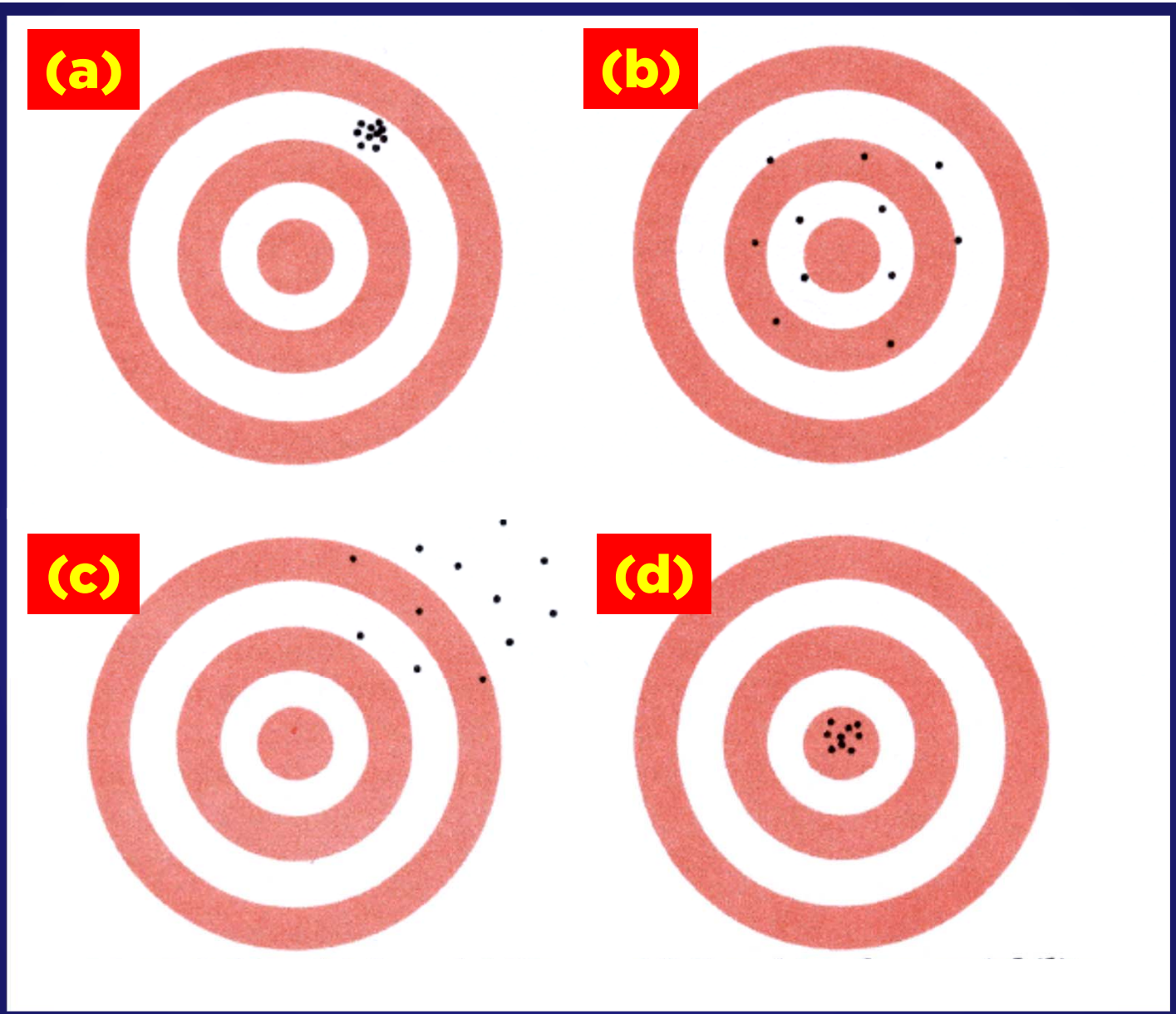
- **Systematic Sampling**
  - Randomly select a starting point, then take (for example) every 10^{th} (or 20^{th}, or 5^{th}, etc.) subject…
- **Multistage Sampling**
  - Randomness is involved at **more than one** stage
  - Be careful not to confuse with CLUSTER sampling

bias ≠ error

Bias: Something that causes your measurements to systematically miss in the same direction every time. This is bad.

Sampling "error" is just sampling variation. (If you flip a coin 10 times, you won't ALWAYS get 5 heads & 5 tails... some variation is inevitable with randomness)




(a)
(b)
(c)
(d)

so if samples are prone to sampling error,
why not conduct a census **EVERY TIME?**

Taking a CENSUS of the population is (usually) time-consuming and (often) error-prone

Types of data – Numerical vs Categorical

Numerical: Does it make sense to take an average?

Catergorical: Cannot take an average, but we CAN take a proportion (or percentage) of...

C C N C C N C

Name	Job Type	Age	Gender	Race	Salary	Zip Code
Jose Cedillo	Technical	27	Male	Hispanic	52,300	90630
Amanda Childers	Clerical	42	Female	White	27,500	90521
Tonia Chen	Management	51	Female	Asian	83,600	90629

A research group wishes to know the mean GPA of all 2600(ish) students at Podunk High School. To estimate this, they take a random sample of 189 students that are enrolled in Pre-AP/AP math classes, and pull those records. The mean GPA of the students in the sample is 3.38. According to the school registrar, the GPA of all 2600(ish) students at Podunk High School is 3.09.

Identify the following

a) Population (of interest): (WHO are we interested in?)
ALL students at PHS

b) Parameter of interest: (WHAT are we interested in?)
Mean GPA of ALL students at PHS

c) Sampling frame: (who had a CHANCE of being selected?)
All students enrolled in Pre-AP/AP Math

d) Sample: (who was actually selected?)
The 189 students.

GPA is numerical data:
3.09 – this number is the PARAMETER (refers to the population)
3.38 – this number is the STATISTIC (refers to the sample)

A neighborhood interest group wants to know what proportion of households in Austin watch the TV show "Dancing with the Comets." They select a random sample of 59 houses from Northwest Austin, and find that 35.6% of those families watch the program regularly. Local ratings indicate that about 22% of all households watch "Dancing with the Comets" on a regular basis.

Identify the following

a) Population (of interest): Households in Austin (probably ALL of Austin)

b) Parameter of interest: What proportion of households in Austin watch "DWTC"

c) Sampling frame: Households in Northwest Austin

d) Sample: The 59 houses that were selected.

This is categorical data (think: The answer is Yes/No.
22% or 0.22 – this number is the PARAMETER (refers to the population)
35.6% or 0.356 – this number is the STATISTIC (refers to the sample)

Parameters vs. Statistics

(population) (sample)

	Means *(numerical data)*	Proportions *(categorical data)*
Parameter ("truth")	μ (mew)	p (pee)
Statistics ("estimate")	$\bar{x}$ (x-bar)	$\hat{p}$ (p-hat)

about BIAS…

Bias

- **A systematic error in measuring the estimate**
- favors certain outcomes
- Anything that causes the data to be wrong! It might be attributed to the researchers, the respondent, or to the sampling method!

Sources of Bias

- things that **can cause** bias in your sample
- cannot do anything with bad data

Voluntary response

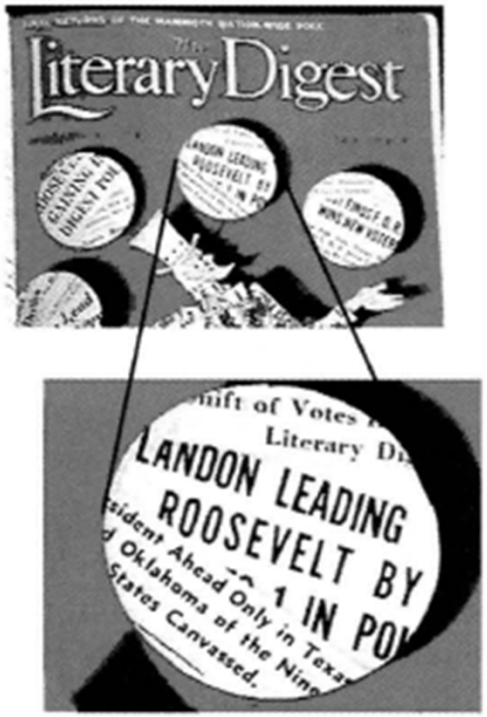
- People chose to respond
- Usually only people with very strong opinions respond
- The way to determine voluntary response: **SELF SELECTION**

Convenience sampling

- Ask people who are easy to ask
- often used for surveys & results reported in newspapers and magazines!
- An example would be stopping friendly-looking people in the mall to survey. Another example is the surveys left on tables at restaurants - a convenient method!

Undercoverage

- some groups of population are left out of the sampling process
- Example: selecting people from the phone book – unlisted numbers are left out



Selecting a sample to represent the population fairly is more difficult than it sounds. Polls or surveys most often fail because they use a sampling method that tends to over- or underrepresent parts of the population. The method may overlook subgroups that are harder to find (such as the homeless or those who use only cell phones) or favor others (such as Internet users who like to respond to online surveys). Sampling methods that, by their nature, tend to over- or underemphasize some characteristics of the population are said to be **biased**. Bias is the bane of sampling—the one thing above all to avoid. Conclusions based on samples drawn with biased methods are inherently flawed. There is usually no way to fix bias after the sample is drawn and no way to salvage useful information from it.

What are the basic techniques for making sure that a sample is representative? Sometimes the best way to see how to do something is to study a really dismal failure. Here's a famous one. By the beginning of the 20th century, it was common for newspapers to ask readers to return "straw" ballots on a variety of topics. (Today's Internet surveys are the same idea, gone electronic.) The earliest known example of such a straw vote in the United States dates back to 1824.

The success of these regional polls in the early 1900s inspired national magazines to try their luck. Although the *Farm Journal* was probably the first, the *Literary Digest* was at the top of the heap. During the period 1916 to 1936, it regularly surveyed public opinion and forecast election results correctly. During the 1936 presidential campaign between Alf Landon and Franklin Delano Roosevelt, the *Literary Digest* mailed more than 10 million ballots. The magazine got back an astonishing 2.4 million. (Polls were still a relatively novel idea, and many people thought it was important to send back their opinions.) The results from the millions of responses were clear. Alf Landon would be the next president by a landslide: 57% to 43%. You remember President Landon, don't you? In fact, Landon carried only two states. Roosevelt won, 62% to 37%, and, perhaps coincidentally, the *Digest* went bankrupt soon afterward.

What went wrong? The problem was that the *Digest* sample was not representative. The pollsters made some mistakes that are now considered classics. First

Nonresponse

- individuals chosen for the sample can't be contacted or **refuse to cooperate**
- NOT the same thing as self-selection (voluntary response)
- telephone surveys 70% nonresponse

Response Bias

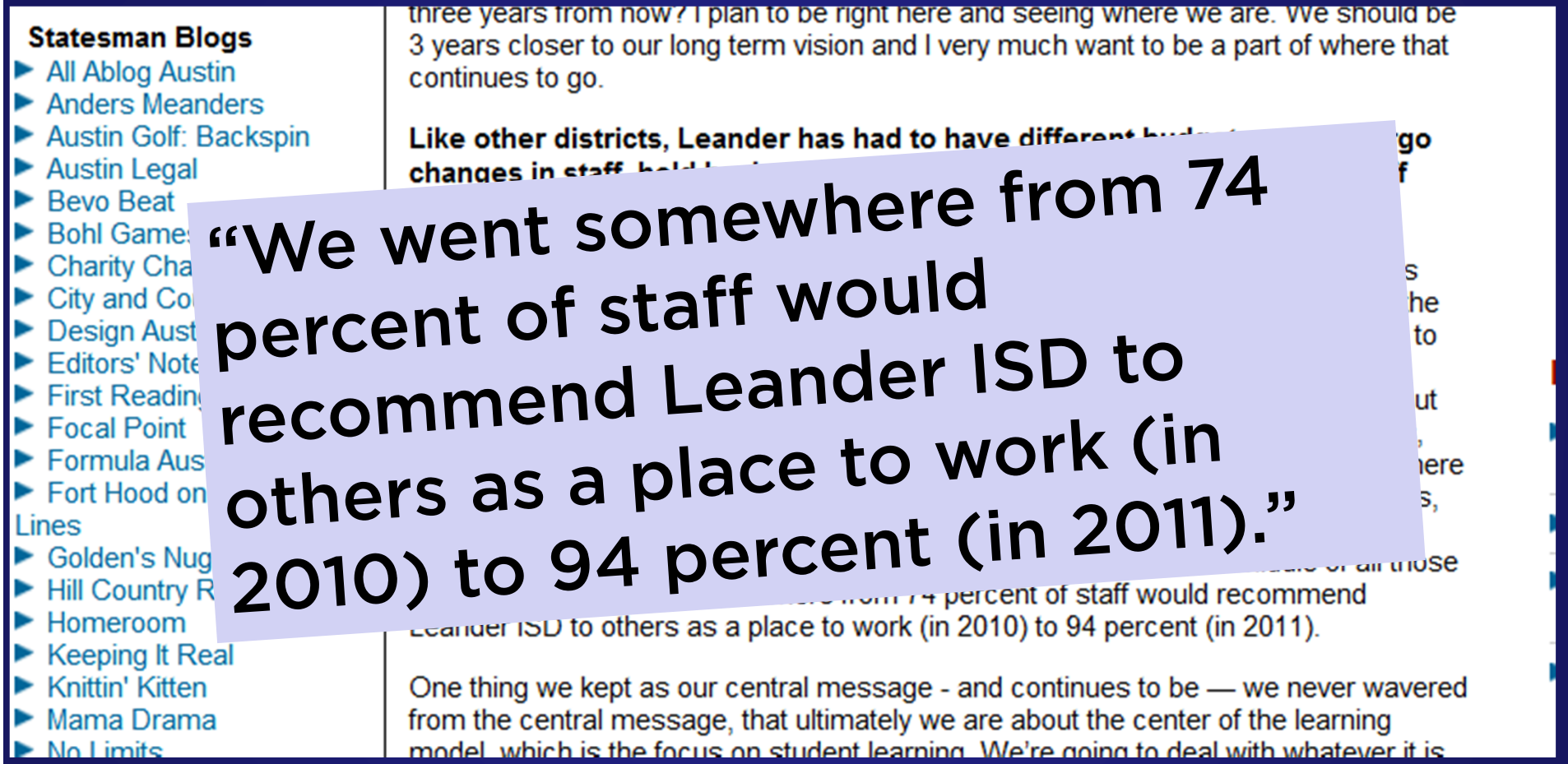
anything in the survey design that influences the responses

- Interviewer bias/intimidation
- Untruthful responses
- The *wording* of a question

(examples of response bias)

- A uniformed campus police office visits your class and asks every student about their drug use in the last 30 days…

- In 2011, Leander ISD was forced to cut a number of jobs due to budget cuts. As part of their exit surveys, they asked teachers the following question:
  "Would you recommend Leander ISD to a friend as a good place to work?"


Statesman Blogs
All Ablog Austin
Anders Meanders
Austin Golf: Backspin
Austin Legal
Bevo Beat
Bohl Game
Charity Cha
City and Co
Design Aust
Editors' Note
First Readin
Focal Point
Formula Aus
Fort Hood on
Lines
Golden's Nug
Hill Country R
Homeroom
Keeping It Real
Knittin' Kitten
Mama Drama
No Limits
three years from now? I plan to be right here and seeing where we are. We should be 3 years closer to our long term vision and I very much want to be a part of where that continues to go.
Like other districts, Leander has had to have different
changes in staff,
"We went somewhere from 74 percent of staff would recommend Leander ISD to others as a place to work (in 2010) to 94 percent (in 2011)."
Leander ISD to others as a place to work (in 2010) to 94 percent (in 2011).
One thing we kept as our central message - and continues to be — we never wavered from the central message, that ultimately we are about the center of the learning model, which is the focus on student learning. We're going to deal with whatever it is

Bias through wording of a question

Subtle differences in phrasing can make a big difference

In January 2006, the *New York Times* asked half of the 1229 U.S. adults in their sample the following question:

After 9/11, President Bush authorized government wiretaps on some phone calls in the U.S. without getting court warrants, saying this was necessary to reduce the threat of terrorism. Do you approve or disapprove of this?

53% of respondents approved.

subtle differences in phrasing can make a big difference!

…but when they asked the other half of their sample a question with only slightly different wording:

After 9/11, George W. Bush authorized government wiretaps on some phone calls in the U.S. without getting court warrants. Do you approve or disapprove of this?

…only 46% approved

subtle differences in phrasing can make a big difference!

a) After 9/11, President Bush authorized government wiretaps on some phone calls in the U.S. without getting court warrants, saying this was necessary to reduce the threat of terrorism. Do you approve or disapprove of this?

b) After 9/11, George W. Bush authorized government wiretaps on some phone calls in the U.S. without getting court warrants. Do you approve or disapprove of this?

BIAS through wording of question

- Spring, 1993, Holocaust Memorial Museum opened in Washington, DC.
- Survey conducted by Roper Starch Worldwide indicated that 22 percent of the American public believed it "possible that the Nazi extermination of the Jews never happened", while another 12 percent were unsure.

- Exact wording of the **Roper** question:

  Does it seem possible, or does it seem impossible to you that the Nazi extermination of the Jews never happened?

- **Gallup** question in a new poll:

  Does it seem possible to you that the Nazi extermination of the Jews never happened, or do you feel certain that it happened?

...less than 1% responded that they thought it was possible it did not happen

stop!