

CSE 564

VISUALIZATION & VISUAL ANALYTICS

VISUAL BIAS

KLAUS MUELLER

COMPUTER SCIENCE DEPARTMENT
STONY BROOK UNIVERSITY

WHAT IS BIAS?

Cause to feel or show inclination or prejudice for or against someone or something



"I trust this site to tell the truth."

CONFIRMATION BIAS

Persistence of mindset

- humans tend to stick with an “opinion” for a long time
- how long does it take you to switch?

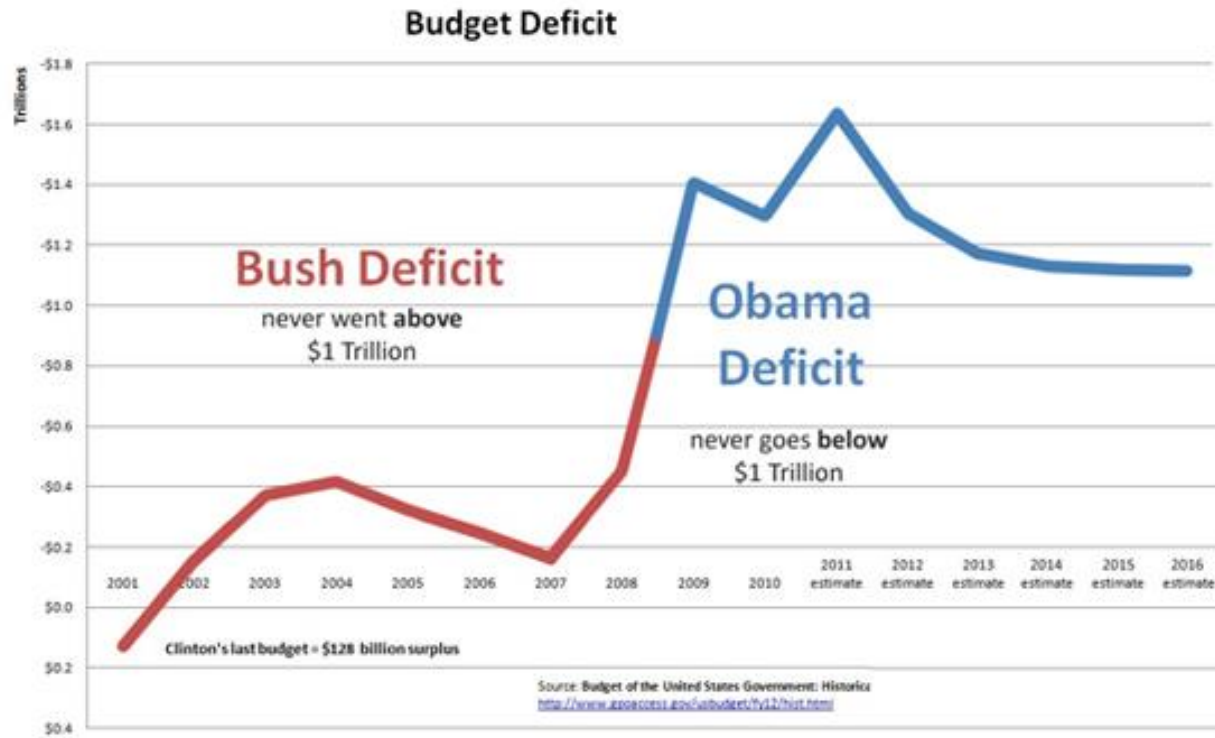


man/woman

Young/old woman



VISUALIZATION CAN SUPPORT BIAS !!

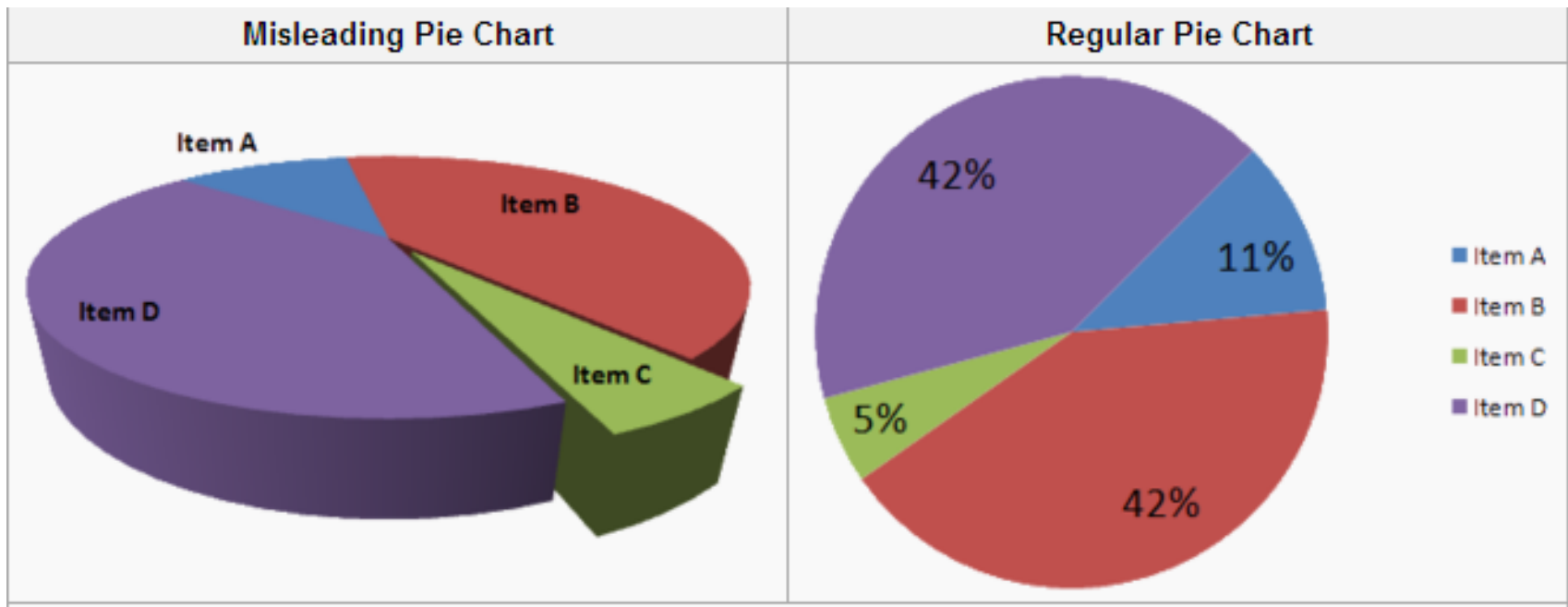


Signal value issues. The red line feels more negative. From <http://www.politicalmathblog.com>

Appeals to cultural bias

- although Obama's deficit was larger, the color red implies that Bush's deficit was more "negative"

GRAPHICAL BIAS



Perspective distortion in 3D rendering causes bias

- in the 3D chart. item C appears to be at least as large as Item A
- whereas in actuality, it is less than half as large.

COGNITIVE BIASES

Impede proper decision making

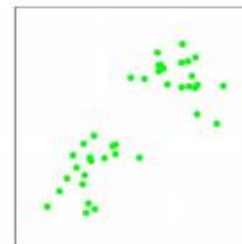
Comes in many guises

THE CONFIRMATION BIAS

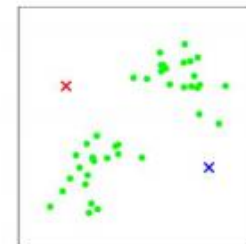
Favor information that confirms previously held beliefs

Which clustering is correct?

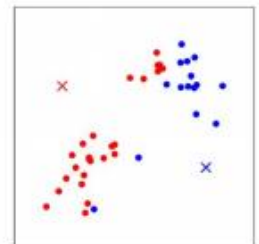
- the one you did first?
- all clusters must look like that?
- many different clusterings
- all are good (or bad)
- depends on task



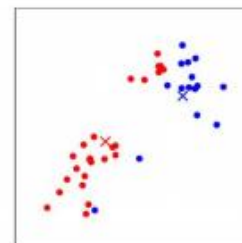
(a)



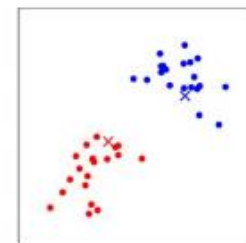
(b)



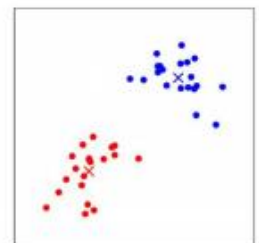
(c)



(d)



(e)



(f)

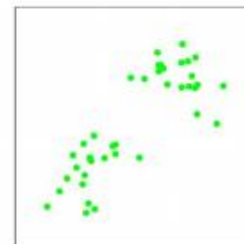
THE HINDSIGHT BIAS

See events, even random ones, as more predictable than they are

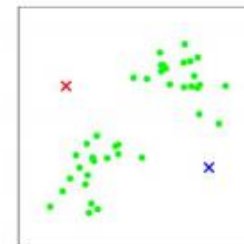
- look back on events and believe that we “knew it all along”

Which clustering is correct?

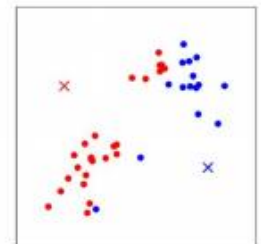
- of course (b) once you ran it
- or is it (d)?



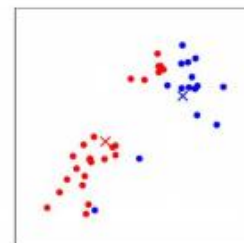
(a)



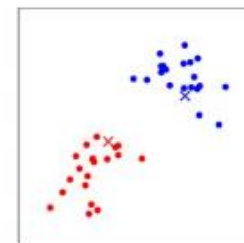
(b)



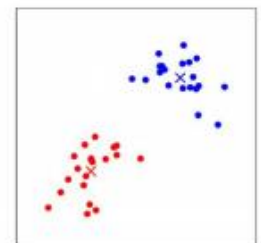
(c)



(d)



(e)

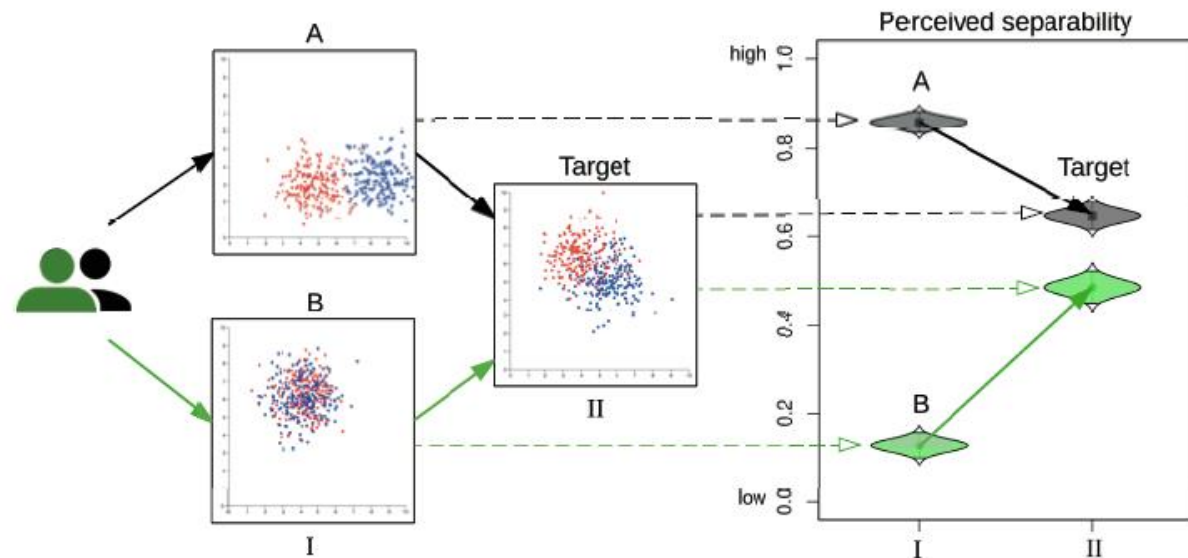


(f)

THE ANCHORING BIAS

Tendency to be overly influenced by the first piece of information that we hear or see

- also called priming
- example: first number heard in pricing negotiations
- example: separability study by Valdez et al.



THE AVAILABILITY HEURISTIC

A strategy that people use to make quick decisions but often lead to systematic errors

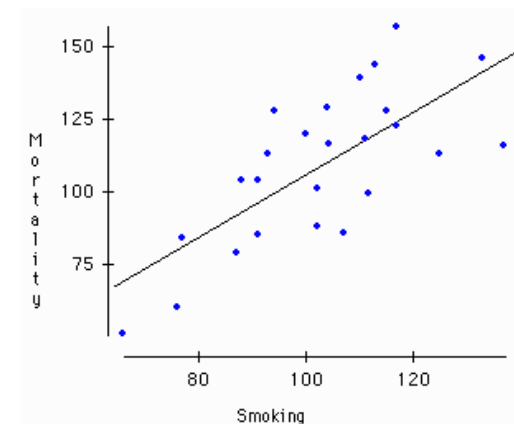
- this can lead to systematic errors, . misconceptions, prejudices

Examples:

- smokers who have never known someone to die of a smoking-related illness, might underestimate the health risks of smoking

Visualization can help overcome this problem

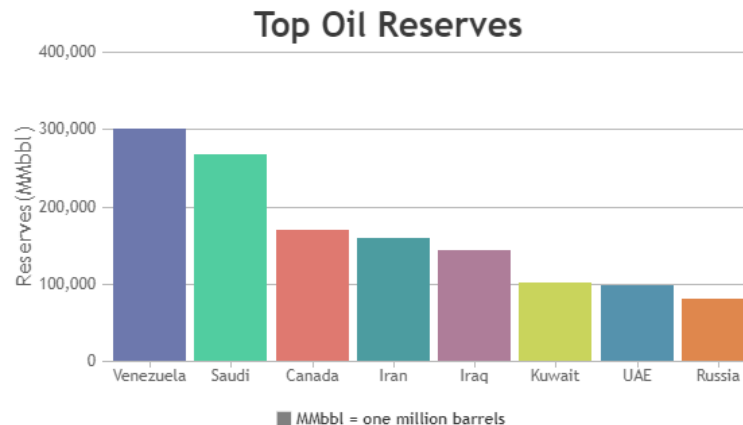
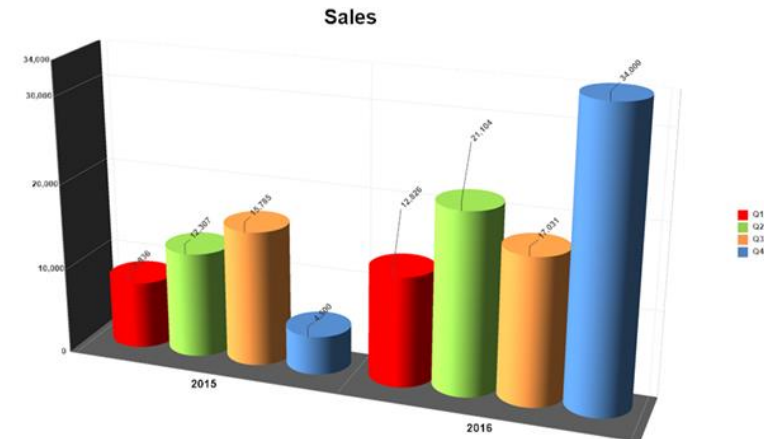
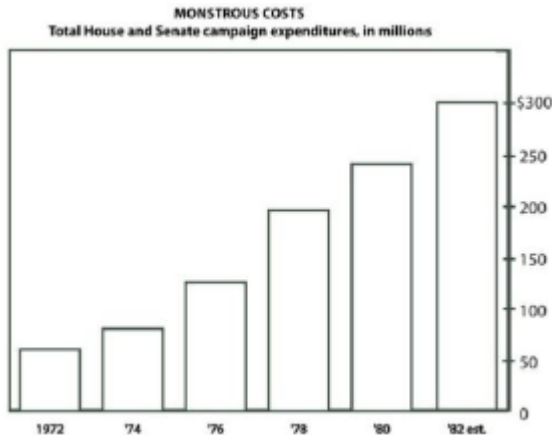
- it can alter the way our memory stores the events for later recall, so as to improve users' long-term intuitions



THE HALO EFFECT

Also known as the "physical attractiveness stereotype" or the "what is beautiful is 'good' principle"

Plain chart vs fancy vs really fancy



OTHER BIASES

The Optimism Bias

- overestimate the likelihood that good things will happen while underestimating the probability that negative events will occur

The Self-Serving Bias

- give yourself credit for successes but lay the blame for failures on outside causes

The False-Consensus Effect

- spend too much time with like-minded people

Solution for all of these (in the context of data science & vis)

- look at data in several ways
- visualize different metrics computed from the data

ONE MORE

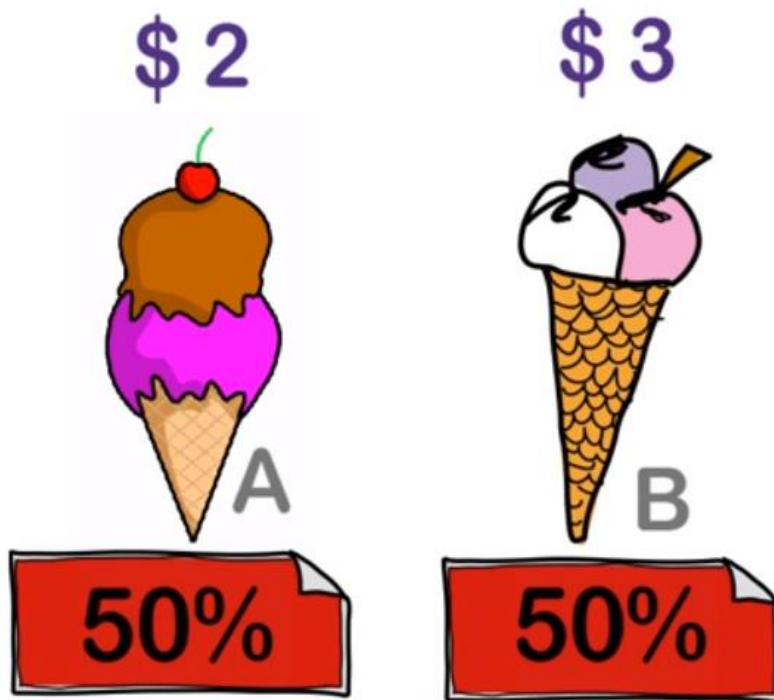
The attraction bias

- exploited in marketing
- can affect visualizations as well
- let's learn first about the attraction effect

THE ATTRACTION EFFECT (1)

Assume you can choose among two ice cream cones

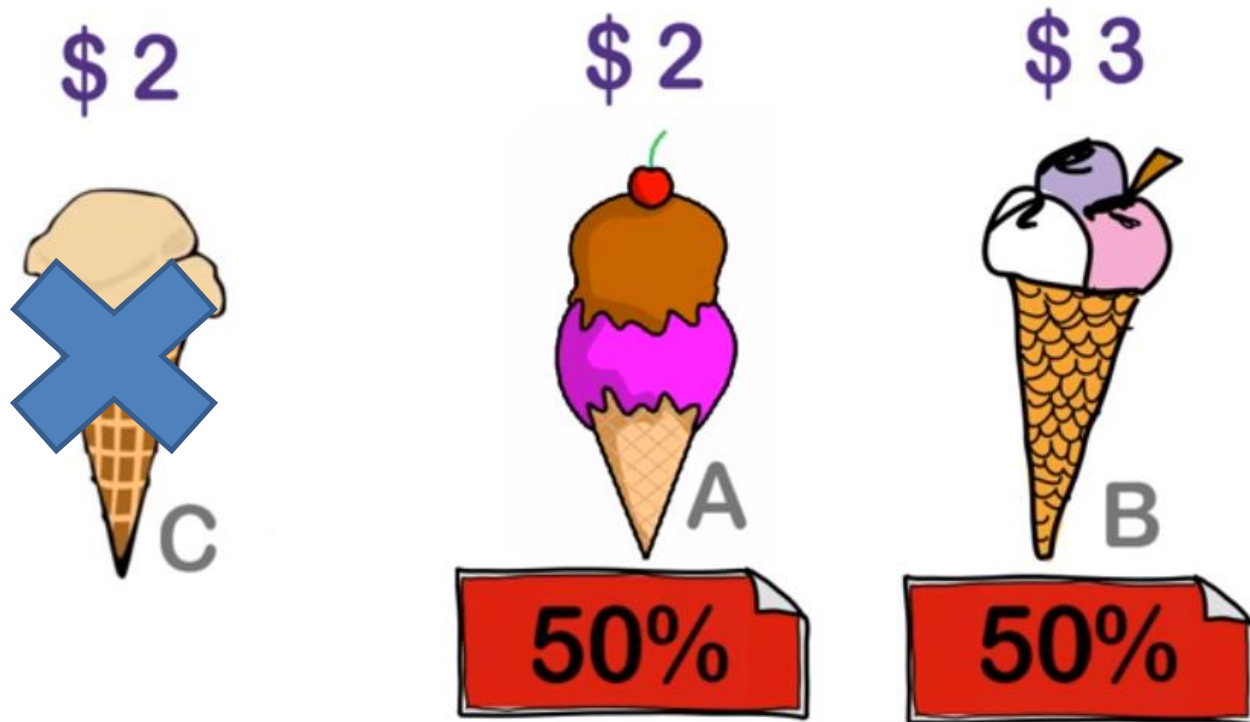
- one has a higher price but offers more scoops
- the other has fewer scoops but also a lower price
- depending on how you feel you will pick either one of them



ice cream cone
A and B have the
same market share

THE ATTRACTION EFFECT (2)

Now suppose there was a third ice cream cone available



- nobody would pick it

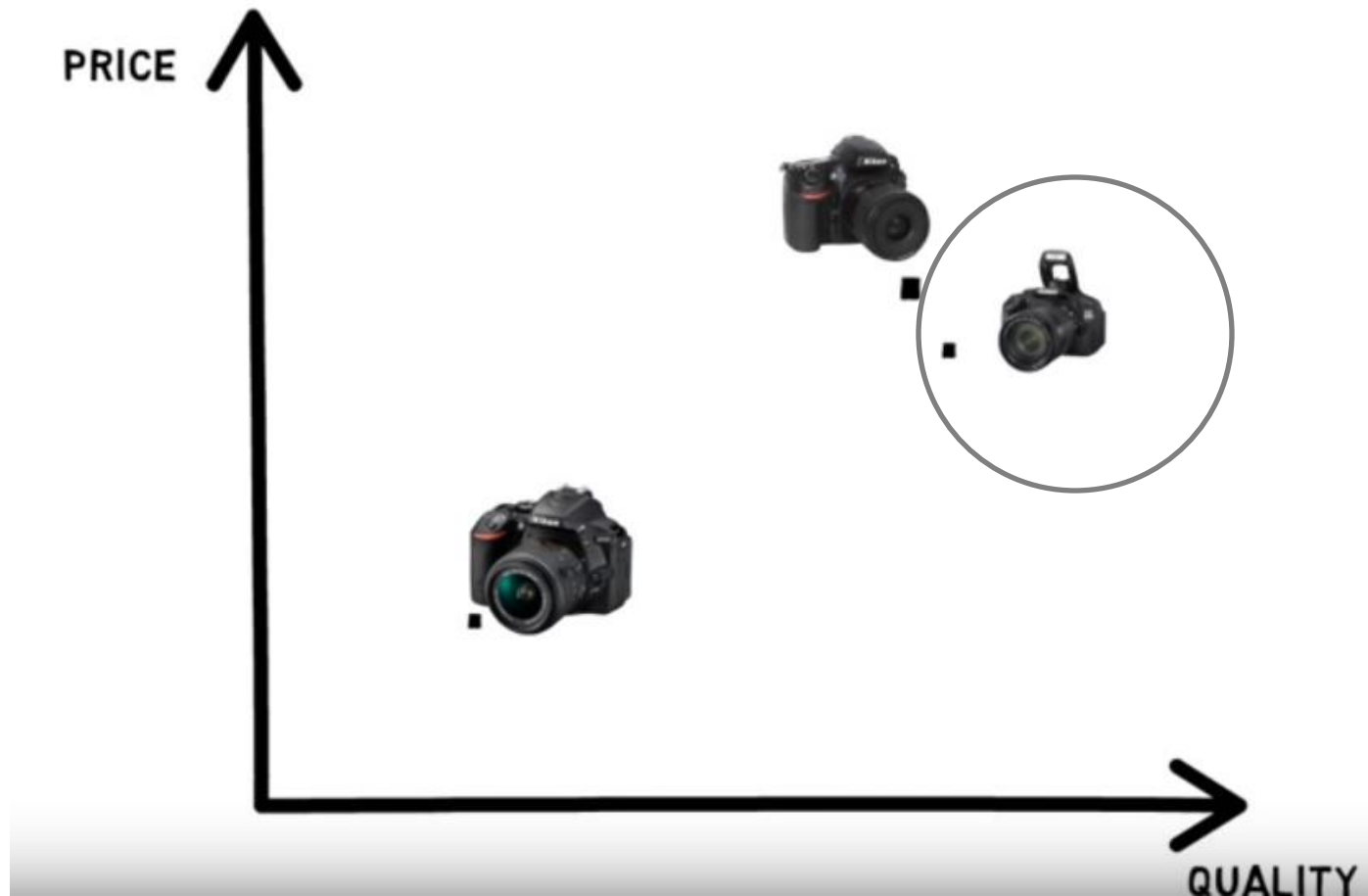
THE ATTRACTION EFFECT (3)

ADDING A THIRD OPTION CAN INCREASE SALES!



Adding the third (inferior) option stole $50\% - 33\% = 17\%$ market share from ice cream cone B and gave it to A

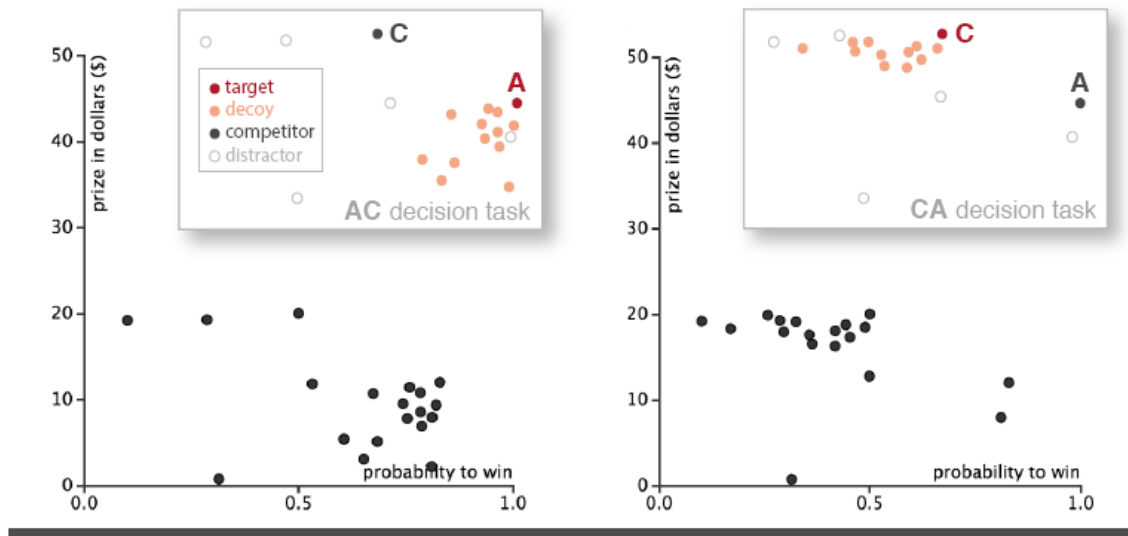
ONE MORE EXAMPLE



APPLICATION TO VISUALIZATION

Decision making with conflicting goals

- here: lottery prize vs probability of winning – which ticket will you buy?



Placement of decoys will always make A or C most attractive in selection and attention tasks

- note, the bottom plots were used in the experiment
- the top plots are just for illustration

A MITIGATION TECHNIQUE

Allow user to delete data points

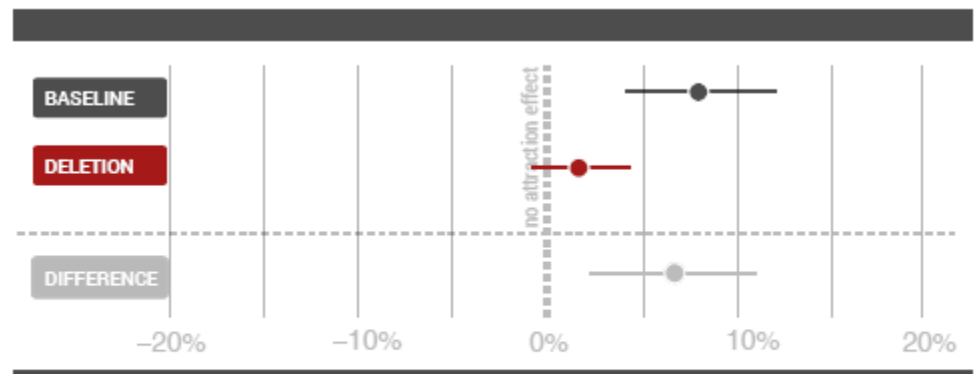
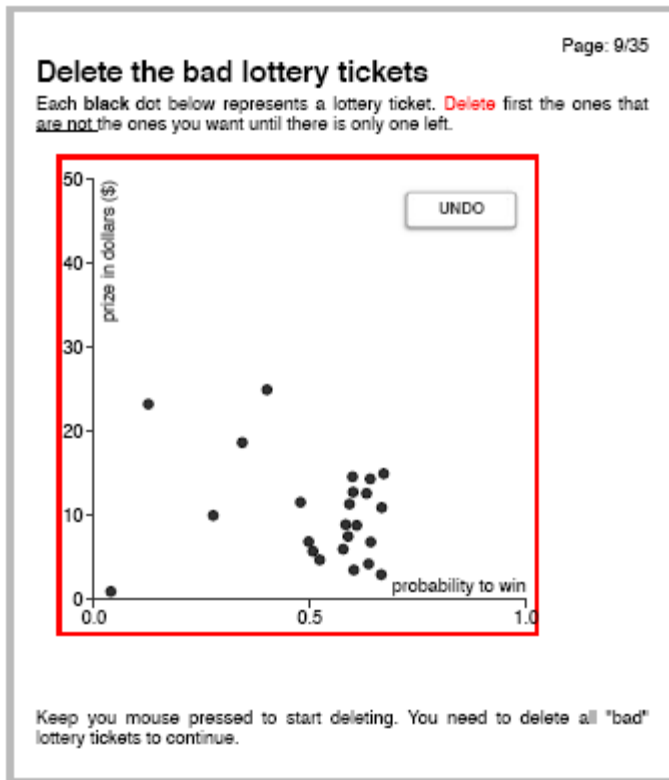


Fig. 8. Point estimates and 95% confidence intervals for the attraction effects in *baseline* and *deletion* conditions.

indeed allowed users to overcome the bias

REFERENCES

Dimara E, Bailly G, Bezerianos A, Franconeri S. [Mitigating the attraction effect with visualizations](#). IEEE Transactions on Visualization and Computer Graphics. 2019 Jan;25(1):850-60.

Valdez AC, Ziefle M, Sedlmair M. [Priming and anchoring effects in visualization](#). IEEE Transactions on Visualization & Computer Graphics. 2018 Jan 1(1):584-94.

The Attraction Effect Explained – [Whiteboard video](#)

20 Cognitive Biases That Screw Up Your Decisions – [weblink](#)

10 Cognitive Biases That Distort Your Thinking - [weblink](#)