Heuristics and Biases I

AEM 4140: Behavioral Econ and Managerial Decisions

Announcements

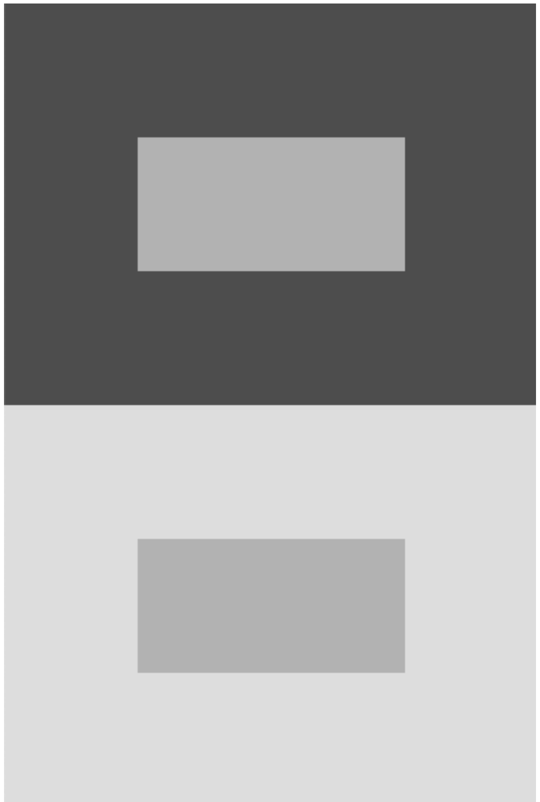
- Group member names due on Feb 9.
- Make sure to bring in $40 course fee to lab.
- Data TA update.

Motivation

- After observing a stock's recent performance, you must decide whether it is a good vs. bad stock to invest in.
- After observing a financial analyst's performance, you must decide whether she is a good vs. bad financial analyst to work with.
- After taking a test drive, you must decide whether you have found a good vs. bad car.
- After interviewing a person, you must decide whether she is a good vs. bad job candidate.
- After receiving a medical-test result, you must assess the likelihood that you have the disease.
- After eating at a restaurant, you must determine whether the food was of high or low quality.

Contrast Effect

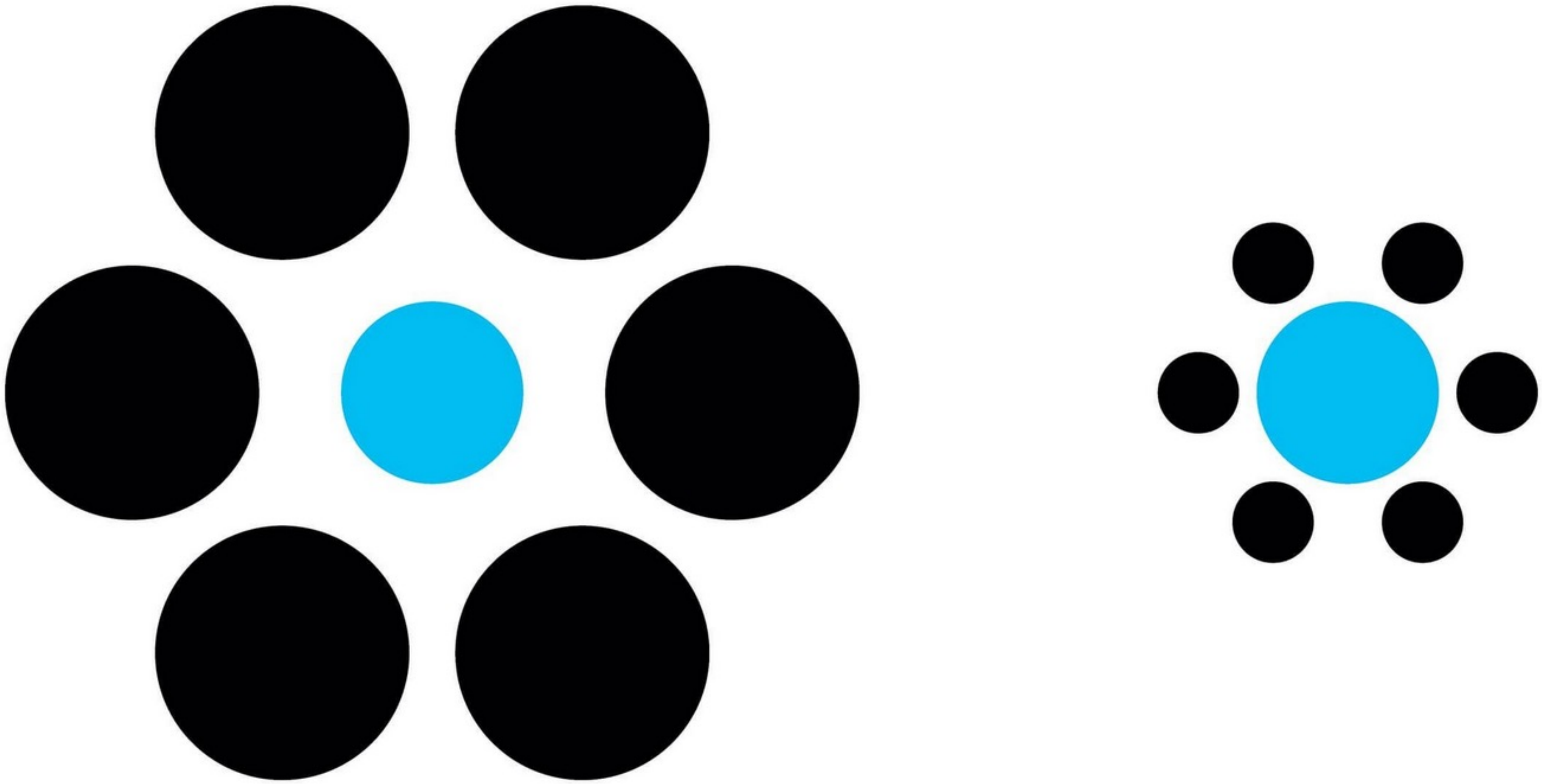
- The enhancement or diminishment of perception or cognition as a result of immediate previous exposure to a stimulus of less or greater value in the same dimension.
- Immediately previous exposures/experiences can alter decisions



Contrast Effect

Anderson & Winawer *Nature* (2005)

Contrast Effect



Contrast Effect

1/2 1/2

"Bad" Gambles

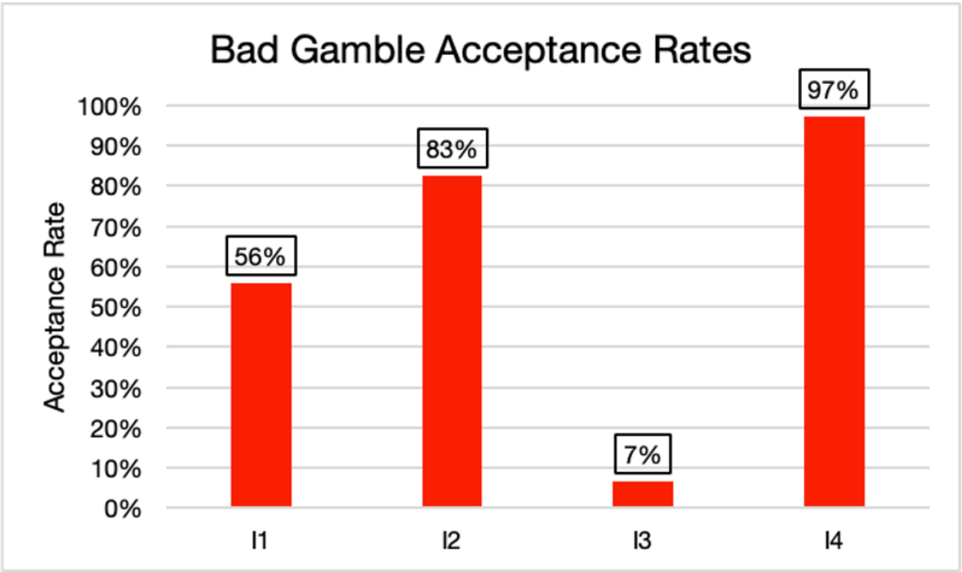
1) 75% +$2; 25% -$5
2) 80% +$2; 20% -$5
3) 75% +$1; 25% -$5

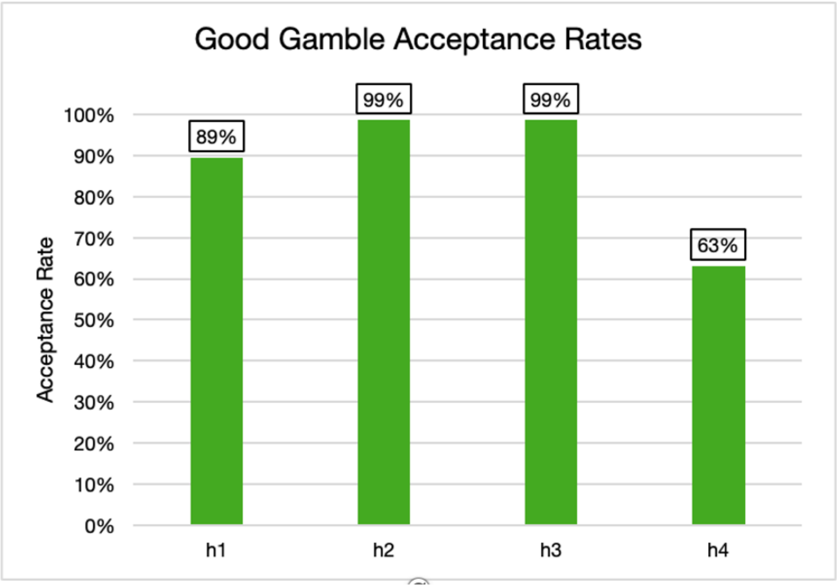
"Good" Gambles

1) 75% +$50; 25% -$5
2) 80% +$50; 20% -$5
3) 75% +$60; 25% -$5

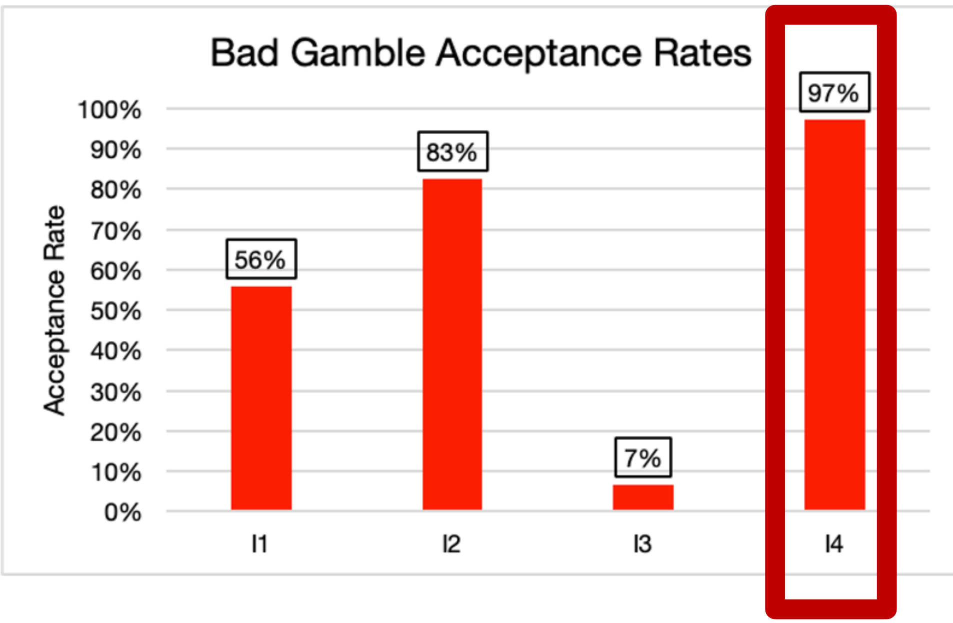
4) 75% +$10; 25% -$5

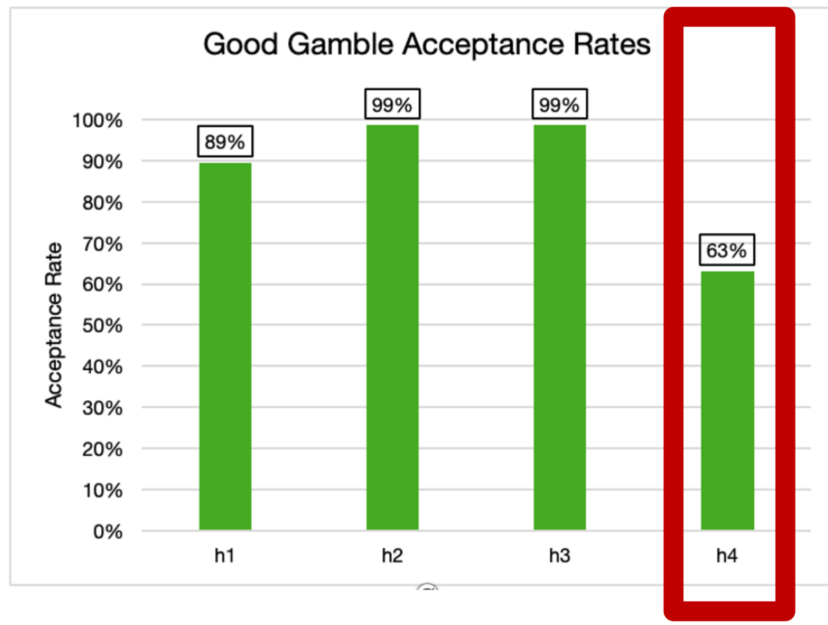
Contrast Effect



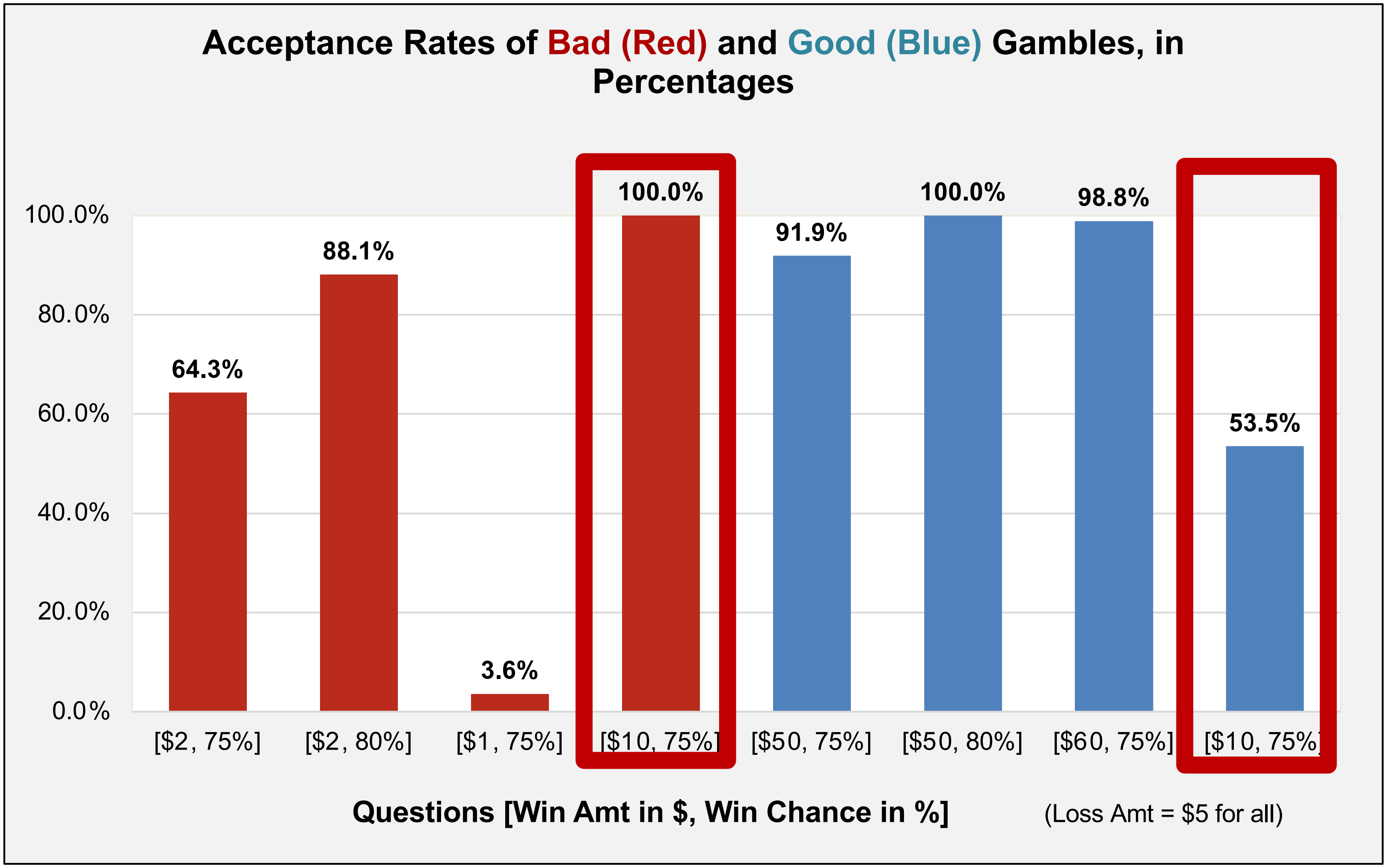


Contrast Effect

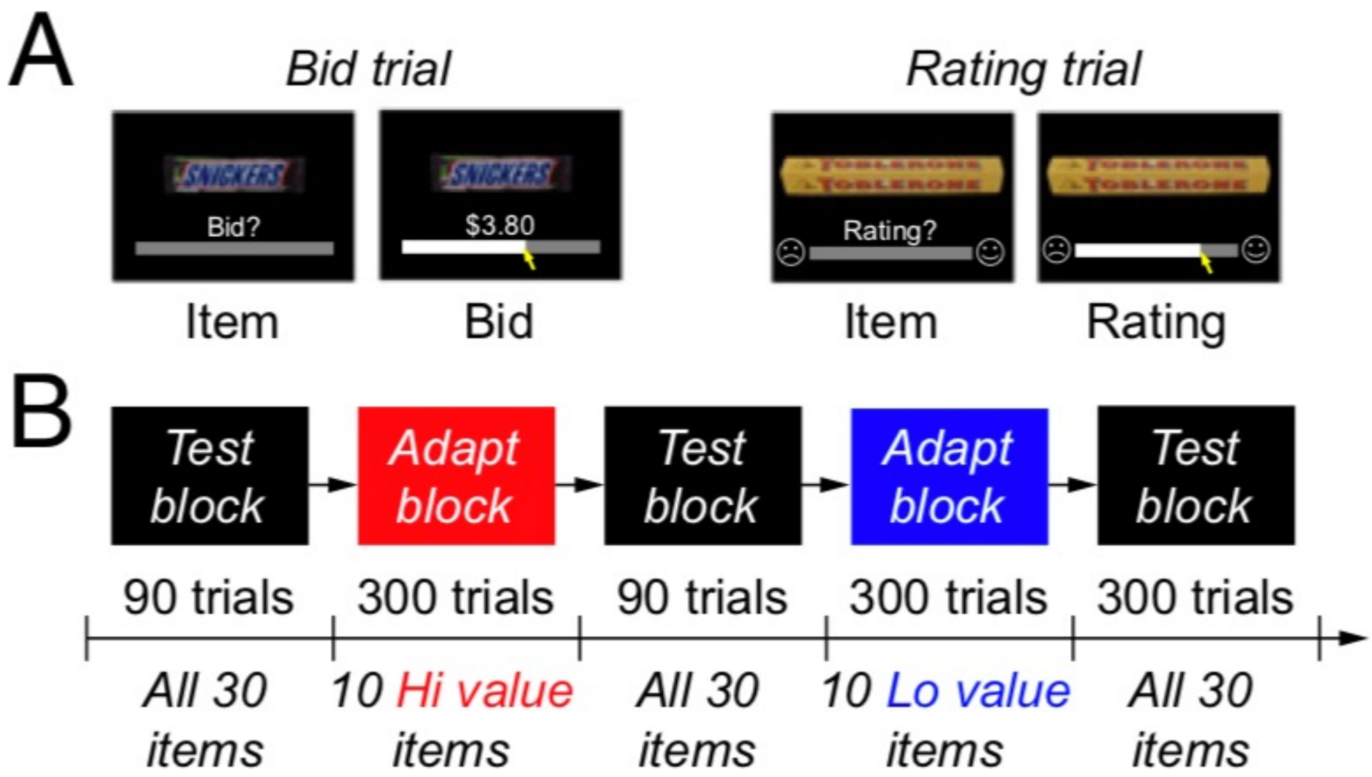




Contrast Effect – Last Year

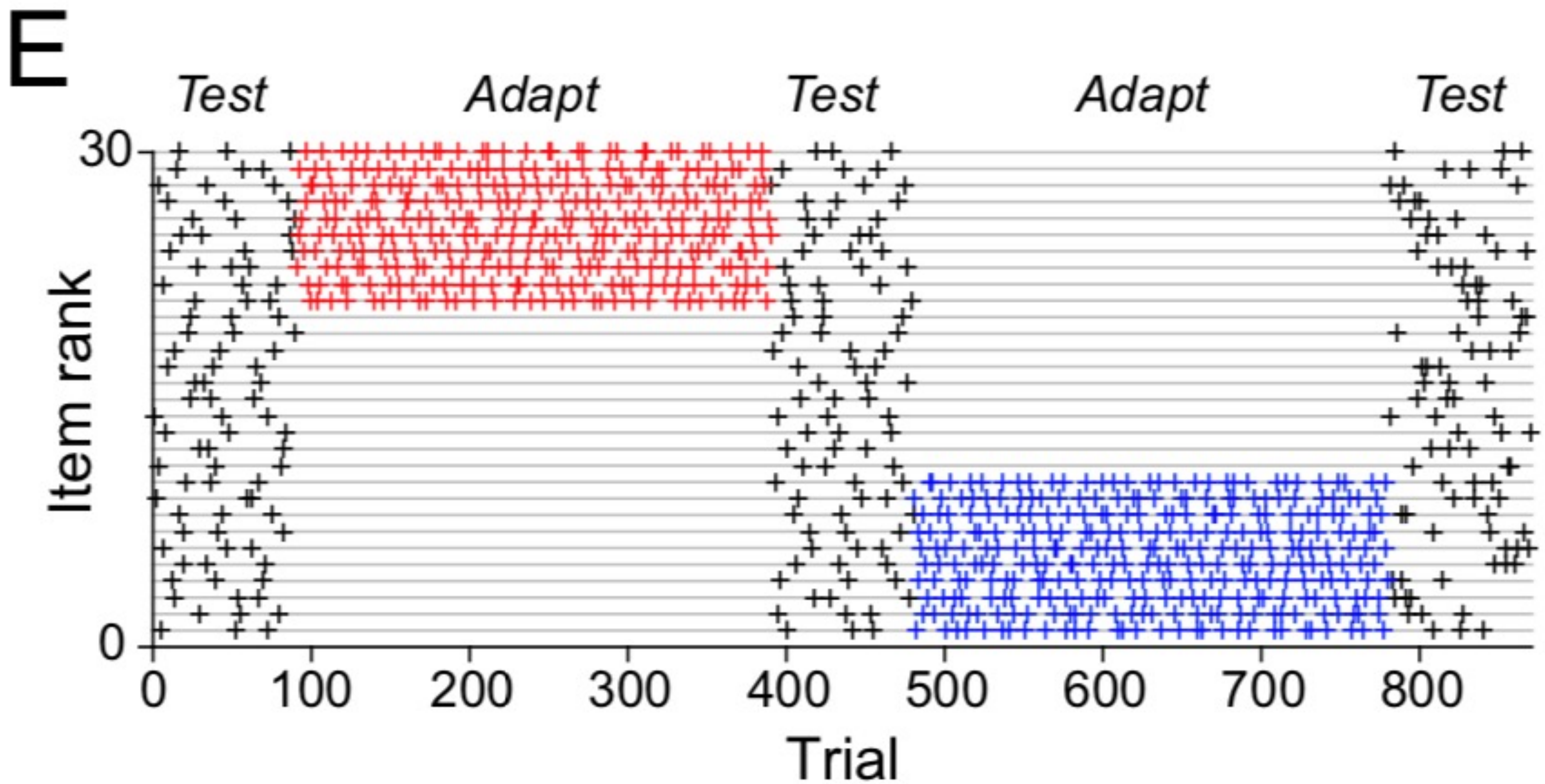


Contrast Effect

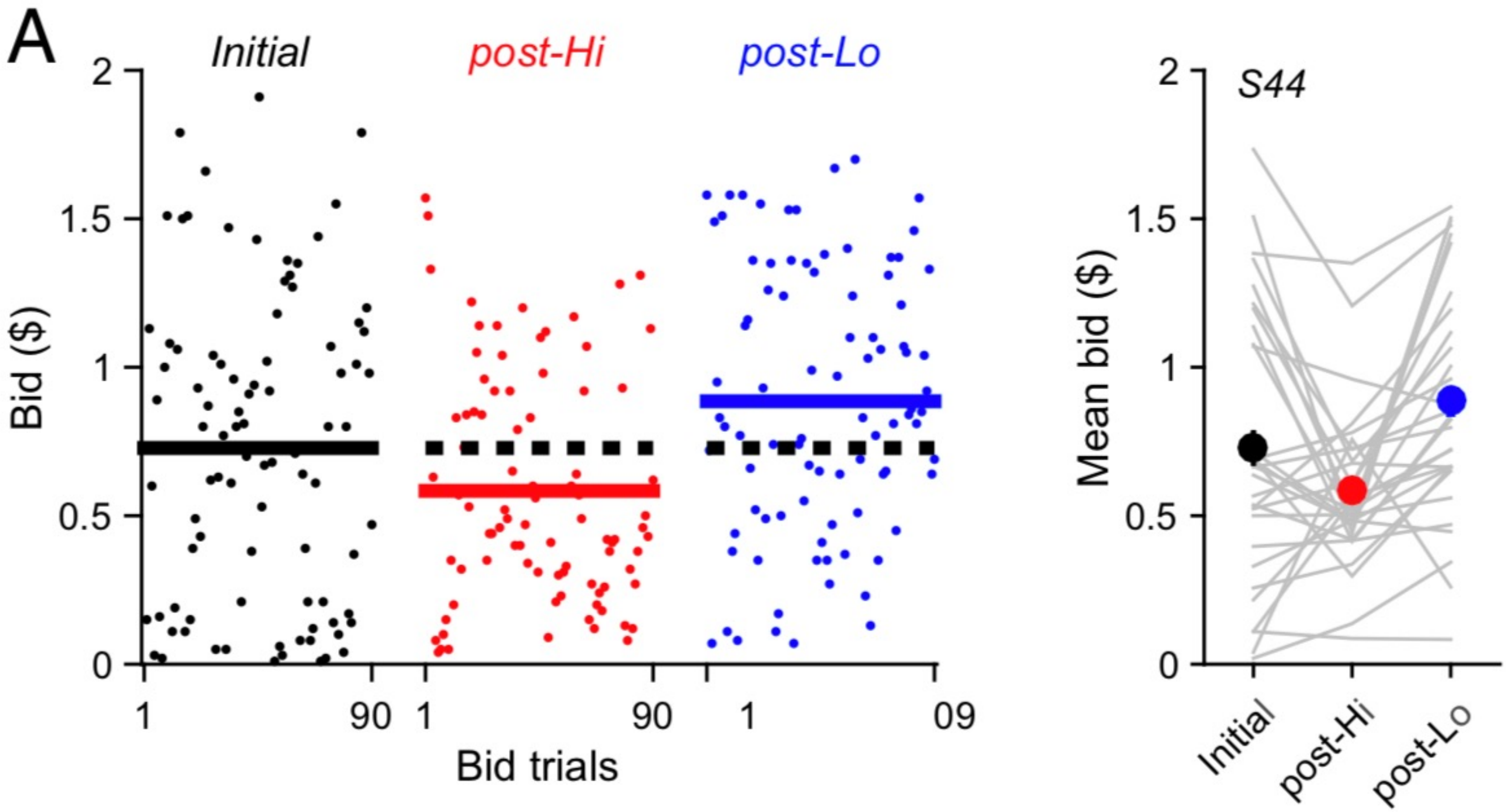


Khaw et al. (2017)

Contrast Effect



Contrast Effect



Contrast Effect

- Comparison of objects should be similar to one another
- Practical consequences
  - Negotiations
  - Consumer purchasing
  - Stock purchases
- Try to evaluate options in isolation in order to avoid this bias

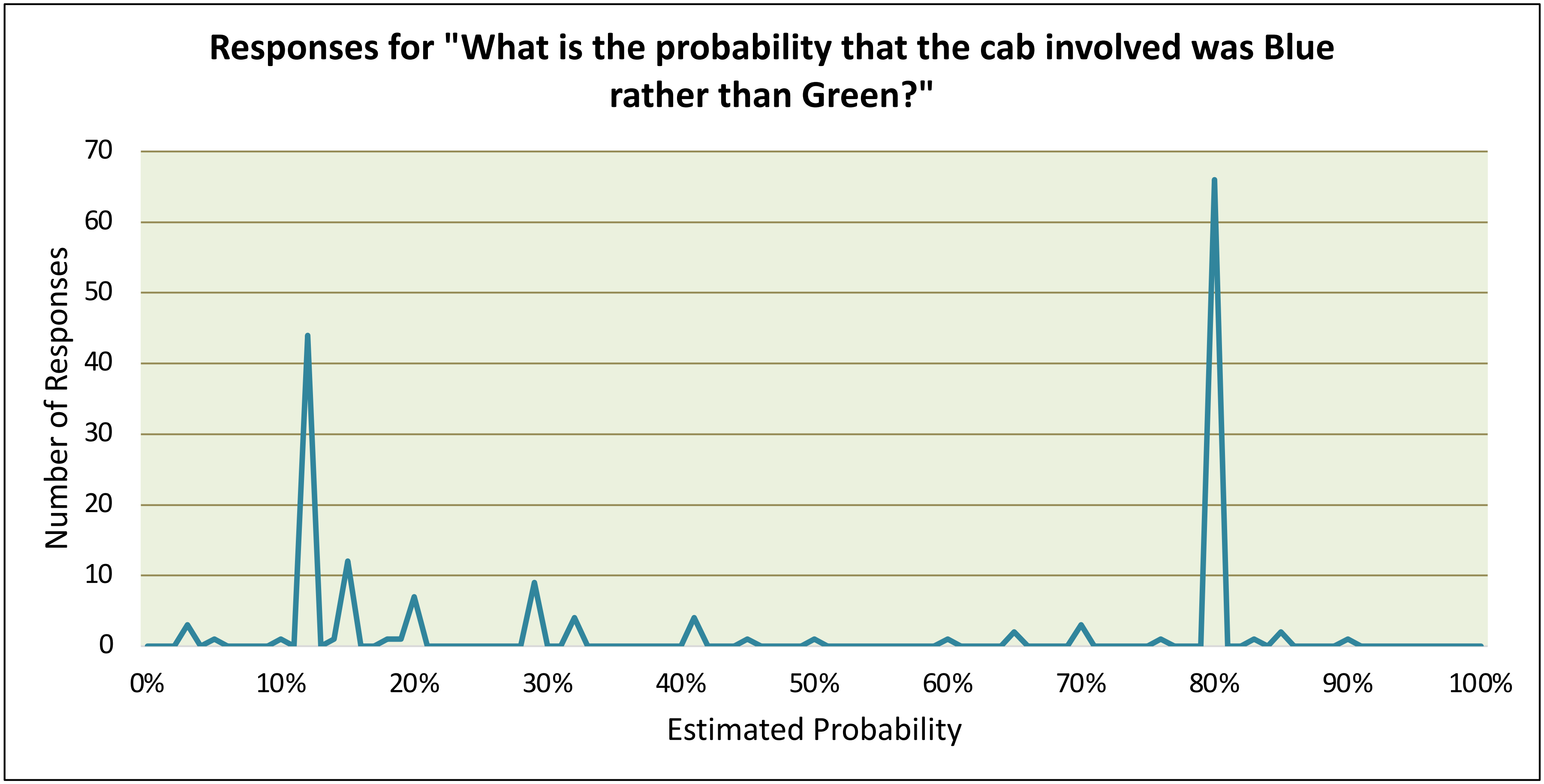
Base Rate Neglect

- People tend to pay too little attention to base rates (i.e., the prior probabilities or general information on prevalence).
- In other words, people do not correctly integrate the base rate information with specific information that pertains only to a specific case

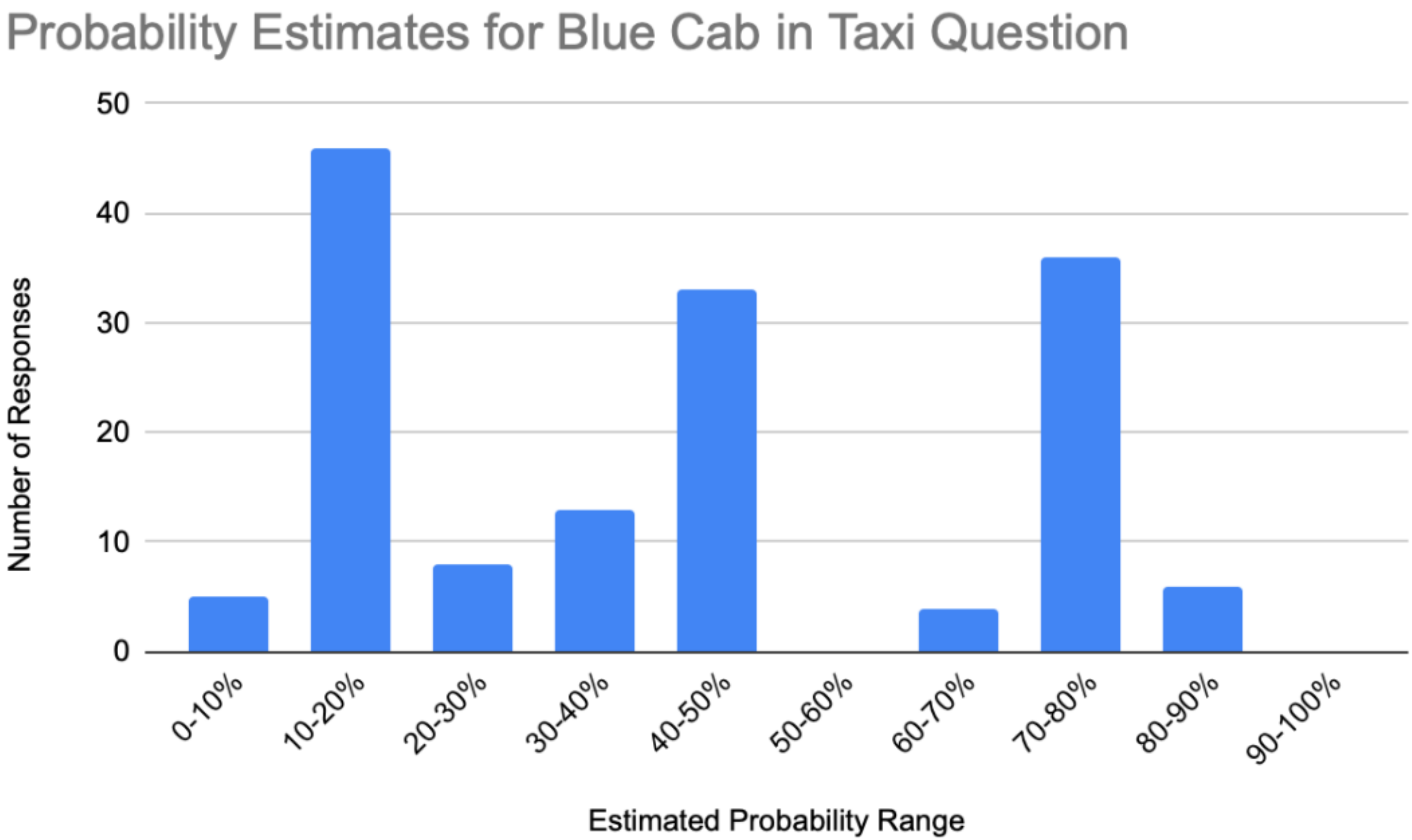
Base Rate Neglect

- A taxi was involved in a hit and run accident at night. There are only two cab companies in the city and they are called Green and Blue.
- You are given the following data:
- (a) 85% of the cabs in the city are Green and 15% are Blue.
- (b) A witness identified the cab as Blue.
- The court tested the reliability of the witness under the same circumstances that existed on the night of the accident and concluded that the witness correctly identified each one of the two colors 80% of the time and failed 20% of the time. What is the probability that the cab involved in the accident was Blue rather than Green?

Base Rate Neglect – Last Year



Base Rate Neglect – This Year



Bayes Rule

$$P(X \mid Y) = \frac{P(X \cap Y)}{P(Y)} = \frac{P(Y \mid X)P(X)}{P(Y)}$$

Law of Total Probability

$$P(Y) = \sum_n P(Y \mid Z_n) P(Z_n)$$

$$P(\text{Umbrella}) = P(\text{Umbrella} \mid \text{Rain})\ \mathrm{P}(\text{Rain}) + P(\text{Umbrella} \mid \text{No Rain})\ \mathrm{P}(\text{No Rain})$$

Base Rate Neglect

- A taxi was involved in a hit and run accident at night. There are only two cab companies in the city and they are called Green and Blue.
- You are given the following data:
- (a) 85% of the cabs in the city are Green and 15% are Blue.
- (b) A witness identified the cab as Blue.
- The court tested the reliability of the witness under the same circumstances that existed on the night of the accident and concluded that the witness correctly identified each one of the two colors 80% of the time and failed 20% of the time. What is the probability that the cab involved in the accident was Blue rather than Green?

- Want P(Blue cab | Witness saw Blue)
- P(Witness saw Blue | Blue Cab) = 0.8, P(Witness saw Blue | Green Cab) = 0.2
- P(Blue Cab) = .15, P(Green Cab) = .85

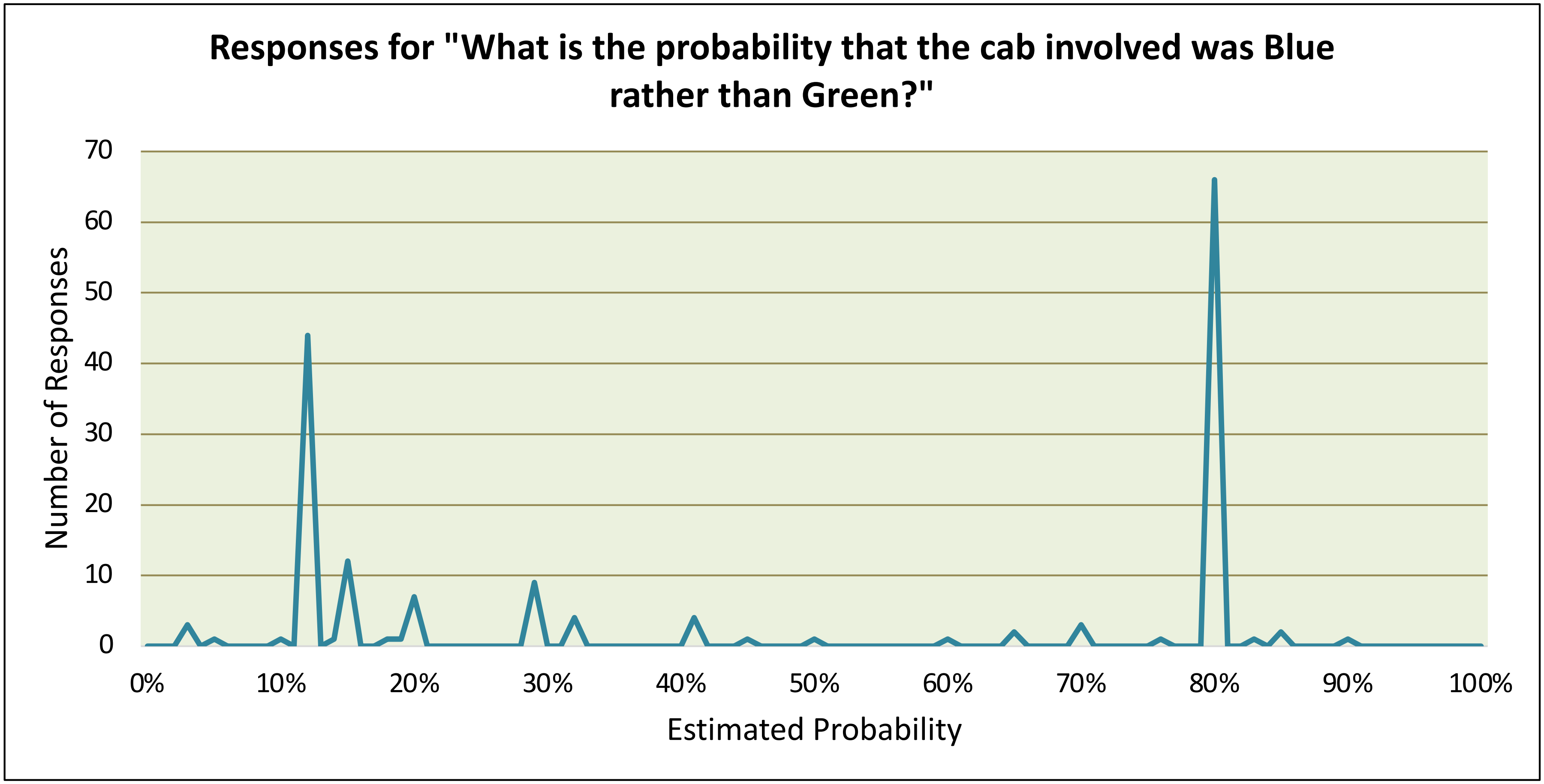
Base Rate Neglect

$$P(\text{Blue cab} \mid \text{Witness saw Blue}) = \frac{P(\text{Witness saw Blue} \mid \text{Blue cab})\ \mathrm{P(Blue\ cab)}}{P(\text{Witness saw Blue})}$$

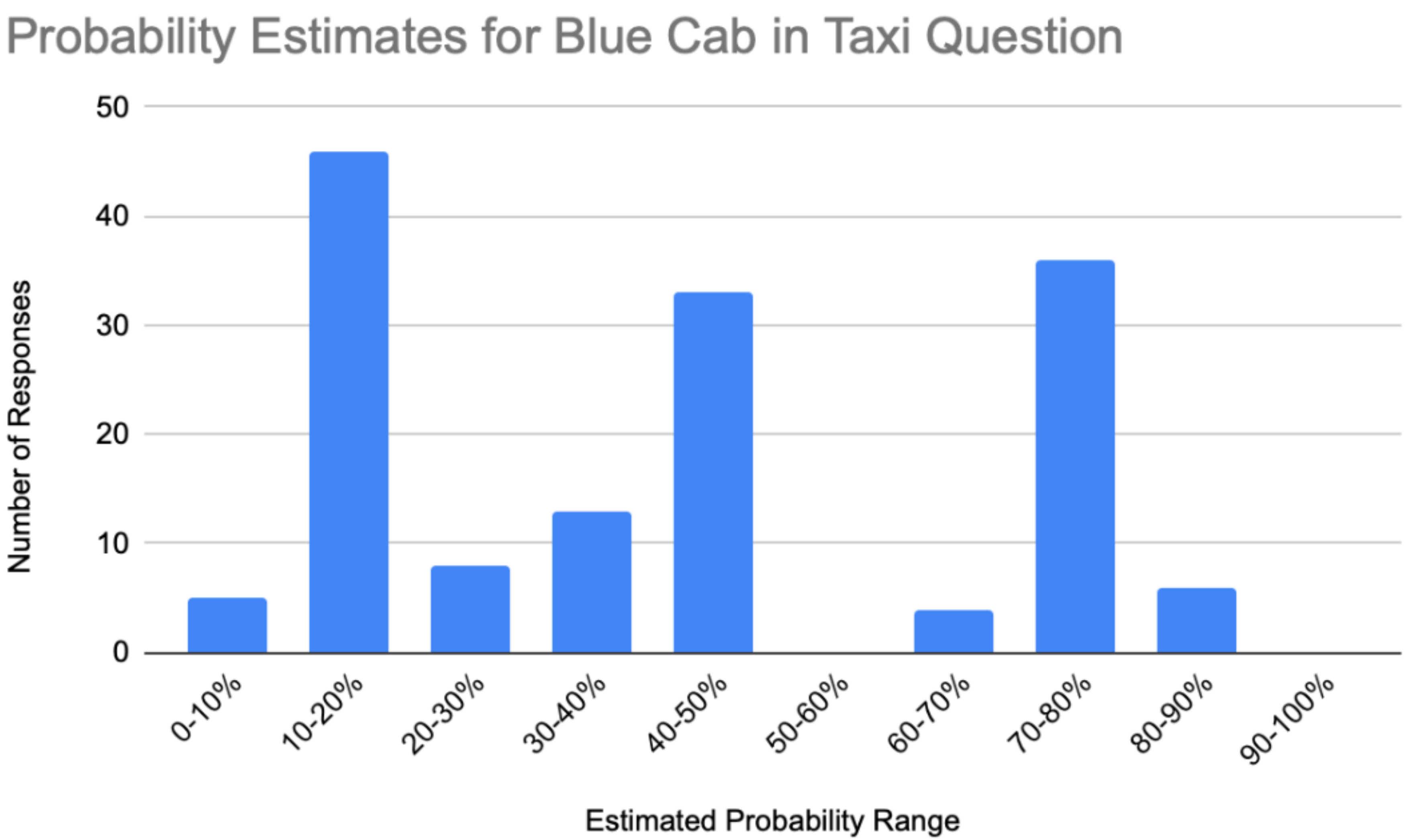
$$\frac{P(\text{Witness saw Blue} \mid \text{Blue cab})\ \mathrm{P(Blue\ cab)}}{P(\text{Witness saw Blue} \mid \text{Blue cab})\ \mathrm{P(Blue\ cab)} + P(\text{Witness saw Blue} \mid \text{Green cab})\ \mathrm{P(Green\ cab)}}$$

$$\frac{(.8)\ (.15)}{(.8)(.15) + (.2)(.85)} = .414$$

Base Rate Neglect – Last Year



Base Rate Neglect – This Year



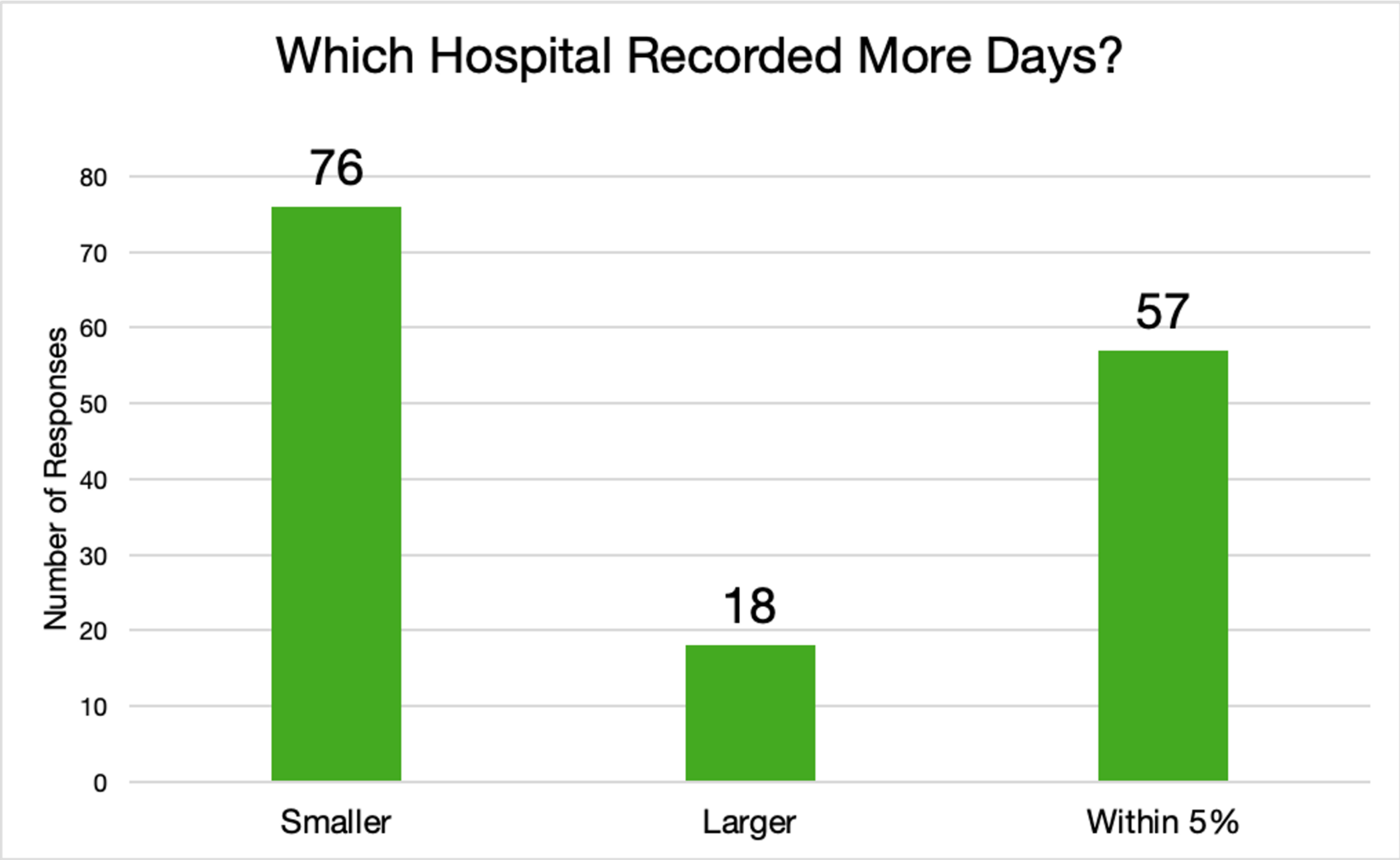
Law of Small Numbers

- People tend to exaggerate the degree to which a small sample will resemble the underlying population
- In other words, people often judge the probability of obtaining a sample statistic (e.g., the mean) without accounting for the sample size.

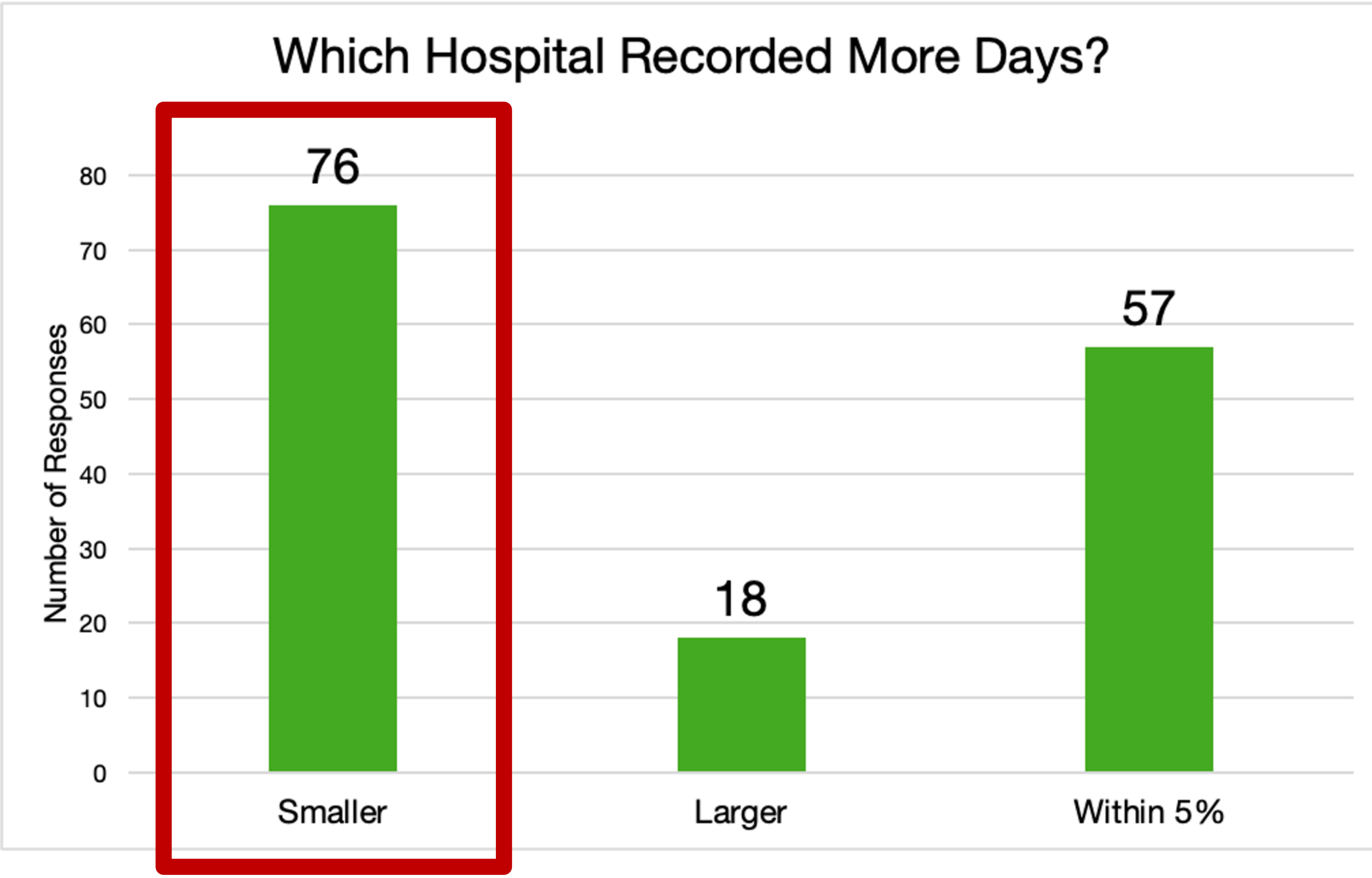
Law of Small Numbers

- A town is served by two hospitals. In the larger hospitals about 45 babies are born each day, and in the smaller hospital about 15 babies are born each day. As you know, 50% of all babies are boys. The exact percentage of baby boys, however, varies from day to day. Sometimes it may be higher than 50%, sometimes lower.
- For a period of 1 year, each hospital recorded the days on which more than 60% of the babies born were boys. Which hospital do you think recorded more such days?

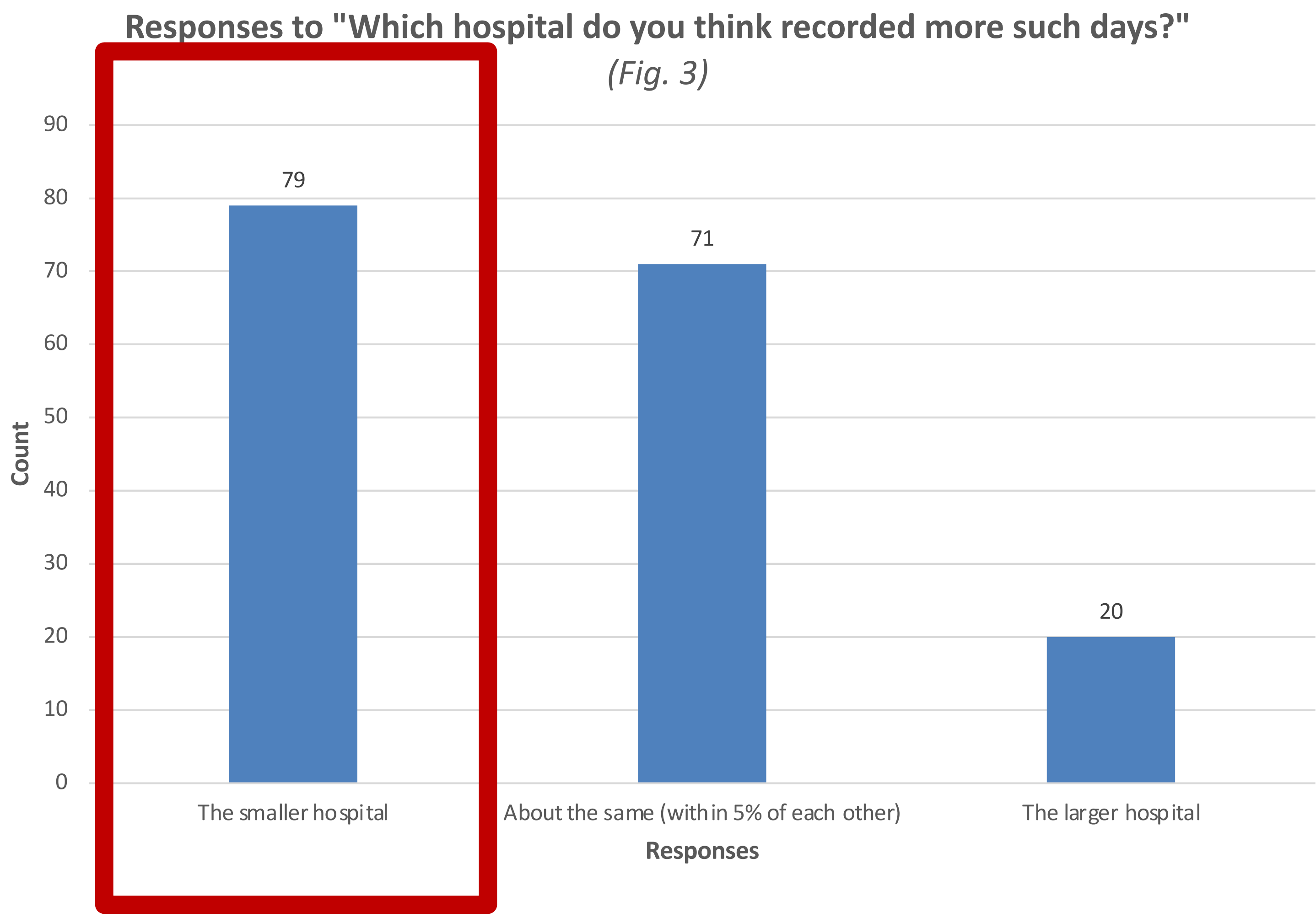
Law of Small Numbers



Law of Small Numbers



Law of Small Numbers



Law of Small Numbers

- Why will the small hospital record more days than the large hospital when more than 60% of births are boys?
- Think about an extreme example of a small hospital with 2 births per day vs a large with 1,000,000 births per day.
- Here, it's relatively easy for the small hospital to have more than 60% boys.
  - Just need 2 boys born in a day. 1 more than expected on average.
- But it's really, really rare for the large hospital to even record a single day with more than 60% boys.
  - Need over 100,000 more boys than expected
- Small samples can be noisy, but as you increase the sample size the result should be closer to the expected value.

Law of Small Numbers

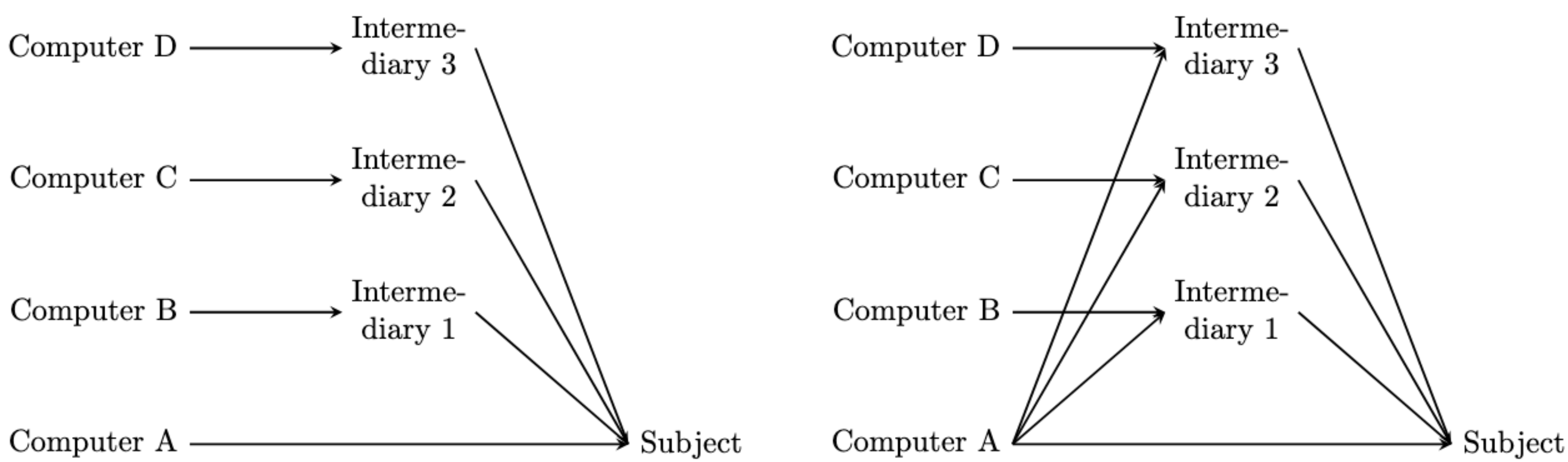
- Kahneman & Tversky (1971) surveyed psychologists and found that they exaggerated the likelihood that true theories would show up as statistically significant in an experiment with a small number of participants.
- Another study found that people assigned the same probability to the likelihood of getting a mean height above six feet in samples of 10, 100, and 1000 men.

Correlation Neglect

- We are often exposed to correlated signals
- News media often share common information sources, such as press agencies, so that the content of different news reports (e.g., newspaper articles, tv shows) tend to be correlated
- In social networks, the opinions of different members are often partly based on information from a shared third party
  - One is confronted with correlated information when communicating
- So similar stories get told multiple times which creates informational redundancies
- We tend to partially ignore this correlation when forming beliefs

Correlation Neglect

Subject's job is to guess the true state of the world, some number given the information (other numbers) they get



Uncorrelated　　　　　　　　Correlated

Enke and Zimmerman (2019)

Correlation Neglect

True State	Rational Belief	Correlation Neglect Belief	Median Belief *Uncorr.* Treatment	Median Belief *Correlated* Treatment	Ranksum Test (p-value)
10	7.75	9.88	8	9.1	0.0002
88	71.25	96.63	71.25	87.5	0.0001
250	259.75	219.38	260	250	0.0028
732	853.15	709.13	850	752	0.0018
1,000	974.75	1,042.38	999	1,030	0.0165
4,698	4,810	3,209	4,810	4,505	0.0001
7,338	8,604.5	9,277.25	9,000	9,152.5	0.8317
10,000	7,232.25	4,887.63	7,232	6,200	0.0001
23,112	26,331	20,745.5	25,000	21,506	0.0001
46,422	38,910.5	25,625	38,885.5	30,277	0.0014

Enke and Zimmerman (2019)

Gambler's Fallacy

- A belief that recent draws of one outcome increase the odds of the next draw being a different outcome
- Examples
  - Black is due in roulette
    - In 1913, roulette ball fell on black 26 times in a row at the Monte Carlo Casino. About 1 in 67 million odds.
  - Lightning never strikes the same place twice
  - Recent lottery winners

Gambler's Fallacy

- Recent lottery winners
  - New Jersey Pick-3 Lottery (Terrell 1994)
  - Money is split among winners. If people pick randomly, E(winnings) = $260.

Table 1. Average payouts to winning numbers

	Number	Mean
Winners repeating within 1 week	8	349.06
Winners repeating between 1 and 2 weeks	8	349.44
Winners repeating between 2 and 3 weeks	14	307.76
Winners repeating between 3 and 8 weeks	59	301.03
Winners not repeating within 8 weeks	1622	260.11
All Winners	1714	262.79

Gambler's Fallacy

- Recent lottery winners
  - Maryland Pick-3 Lottery (Clotfelter and Cook 1993)

Drawing Date	Winning Number	Index of Amount Bet, Q_t: Day before Drawing	Day of Drawing	Days after Drawing: 1	3	7
3/1	295	75	65	34	24	28
3/2	640	29	32	27	17	17
3/3	980	27	24	20	19	17
3/4	957	27	25	20	18	19
3/5	899	18	14	15	13	17
3/7	618	43	44	23	18	23
3/8	639	26	23	22	18	18
3/9	011	260	260	472	212	180
3/10	274	71	69	44	42	50
3/11	472	68	46	54	37	40
3/12	575	23	23	25	15	17
3/14	383	31	30	31	18	20

Gambler’s Fallacy

- When does it not apply?
  - Non-independent events
    - If probability of future events change based on the outcome of past events
    - Drawing playing cards without replacement
  - Bias
    - Flipping unfair coins
  - Changing probabilities
    - External factors might change outcome probabilities

Hot Hand “Fallacy”

- The tendency to perceive positive autocorrelation (i.e., a “hot hand”) in independent and identically distributed sequences.
- A person who experiences a successful outcome has a greater chance of success in further attempts.
- Common in basketball
  - A player who makes several shots in a row is said to have a ”hot hand”

Hot Hand "Fallacy"

- Gilovich et al. (1985) questioned the idea that basketball players have hot hands
  - Studied shot data from the 76s for 48 home games
  - Evidence of a hot hand would suggest that
    - P(Hit | Hit, Hit, Hit) > P(Hit | Miss, Miss, Miss)
  - But the evidence suggests these probabilities are not significantly different
  - No no evidence for the hot hand
- Some recent work finds evidence of a hot hand, but it is likely smaller than expected

Gambler's Fallacy vs Hot Hand

- They make starkly different predictions
  - GF – should expect a reversal following a streak
  - HH – should expect a streak to continue
- We think GF is more likely to occur when people feel an event is random
  - Roulette
  - Random numbers of small samples will balance they way they do in large samples
- Hot hand relies more on an individual's skill
  - Sports

Conjunction Fallacy

Katie is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.

Conjunction Fallacy

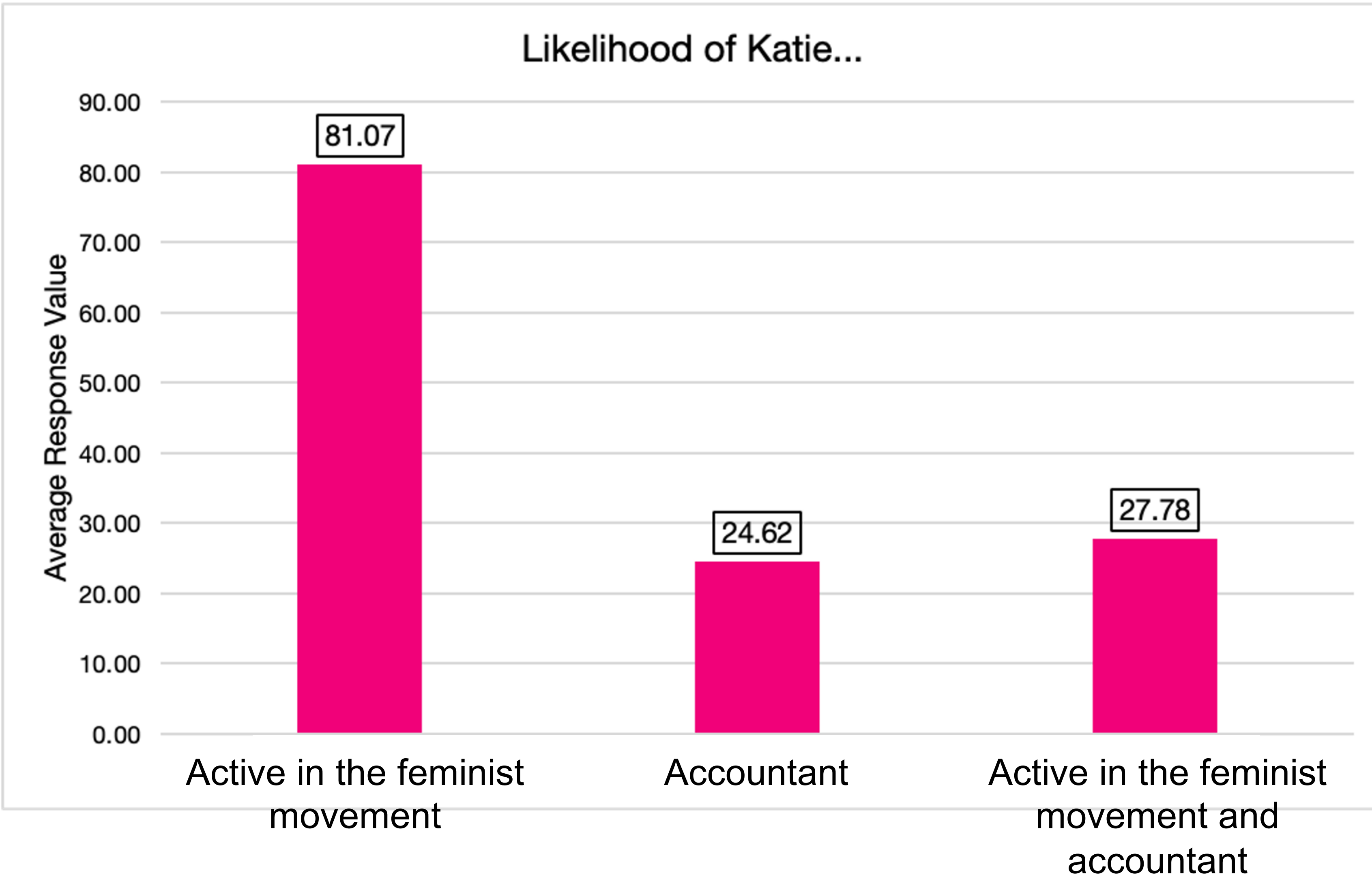
Katie is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.

1) Katie is active in the feminist movement

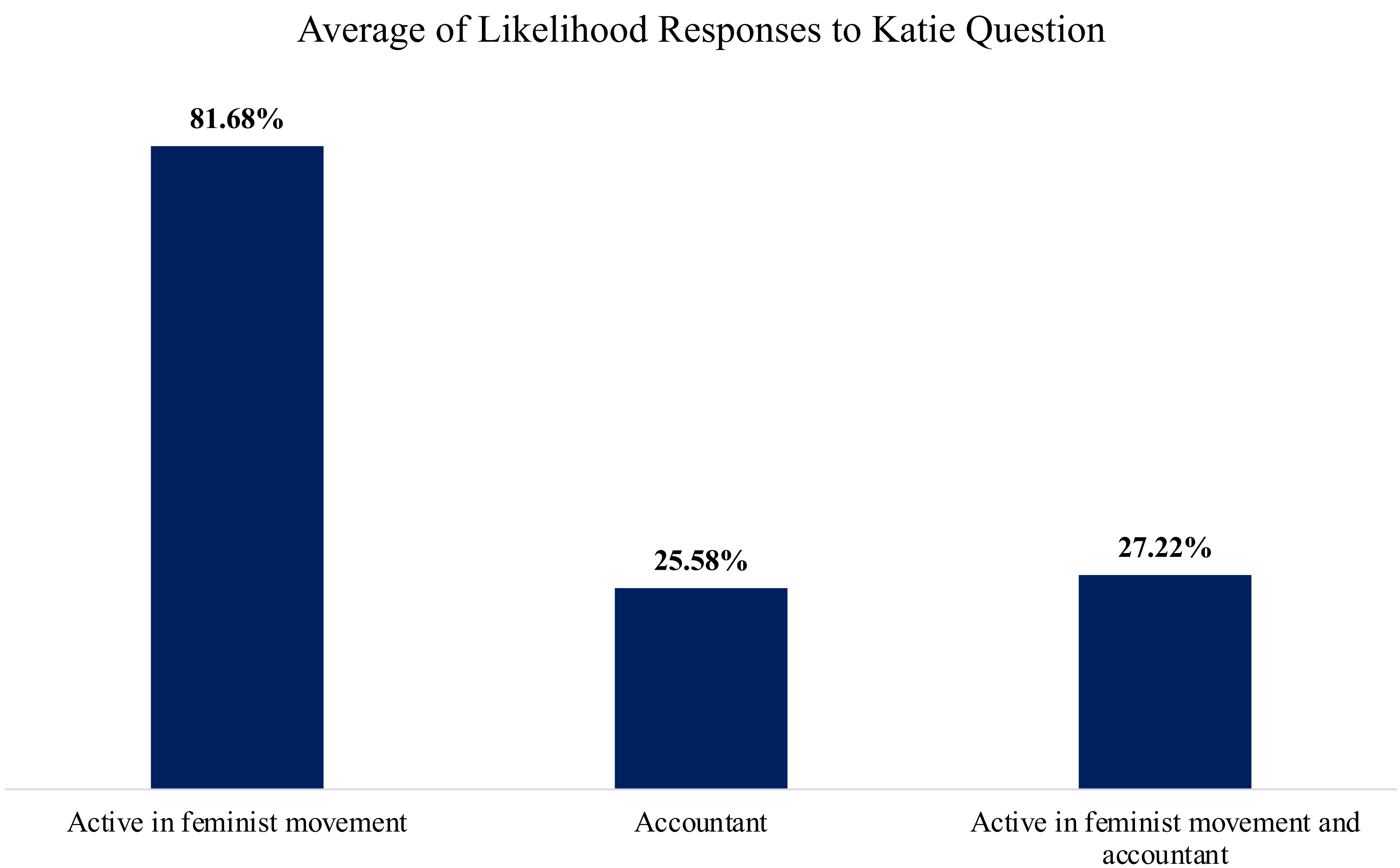
2) Katie is an accountant

3) Katie is an accountant and is active in the feminist movement

Conjunction Fallacy



Conjunction Fallacy – Last Year



Conjunction Fallacy

- 34% of the class rated the likelihood of being involved in the feminist movement and an accountant as more likely and just being an accountant
  - This would be example of a conjunction fallacy
- The probability of two events occurring together (i.e., in conjunction) is always <= the probability of either occurring alone
  - P(A and B) <= P(A)