Ignoring base rates

- People were told that they would be reading descriptions of a group that had 30 engineers and 70 lawyers.
- People had to judge whether each description was of an engineer or a lawyer. They gave a number that reflected their confidence in their judgement.
- They should have factored in the base rate: the overall likelihood that a given case will fall in a given category

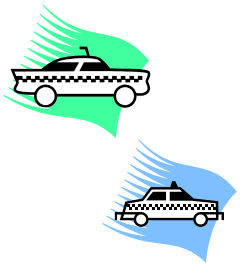
Ignoring base rates (cont.)

- If the description matched people's stereotype of an engineer, they judged that the description was of an engineer
- People's judgments were not influenced by different base rate information (70 engineers and 30 lawyers vs. 70 lawyers and 30 engineers)

Improving our judgments

- People are more likely to use statistical knowledge when it is triggered by the situation.
- When people had to judge descriptions as belonging to a lawyer vs. engineer, they did better when they drew the descriptions out of a jar -- they made use of base rate information
- Highlighting the role of chance improves judgment.

Base Rate Neglect



- 85% cabs green
- 15% cabs are blue
- Witness: "Cab was blue."
- Witness: 80% accurate when identifying colors in similar conditions
- What's the probability that the cab in the accident was blue?
  - Survey Says: 80%
  - Bayes Says: 41%

When Base Rate Matters

- 85% of accidents involve green cabs
- 15% of accidents involve blue cabs
- Witness: Cab was blue.
- Witness: 80% accurate when ID-ing colors
- What's the probability the cab was blue?
  - Survey says: 60%
  - Bayes (still) says: 41%

Causal scenarios make base rates relevant

Probabilities vs. Frequencies

The probability of breast cancer is 1% for a woman at age 40 who participates in routine screening. If a woman has breast cancer, the probability is 80% that she will get a positive mammography. If a woman does not have breast cancer, the probability is 9.6% that she will get a positive mammography. A woman in this age group had a positive mammography in a routine screening. What is the probability that she actually has breast cancer?

Frequency & Probability Formats for a Bayesian Inference Problem

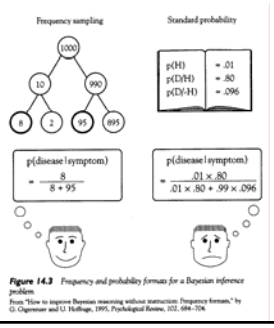


Figure 14.3 *Frequency and probability formats for a Bayesian inference problem.*
From "How to improve Bayesian reasoning without instruction: Frequency formats," by G. Gigerenzer and U. Hoffrage, 1995, *Psychological Review, 102*, 684–704.

Three Major Heuristics/Biases

(Tversky and Kahneman, 1974)

- **Representativeness**
  - The more object X is similar to class Y, the more likely we think X belongs to Y
- **Availability**
  - The easier it is to consider instances of class Y, the more frequent we think it is
- **Anchoring**
  - Initial estimated values affect the final estimates, even after considerable adjustments

The Representativeness Heuristic

- We often judge whether object X belongs to class Y by how **representative** X is of class Y
- For example, people order the potential occupations by **probability** and by **similarity** in exactly the same way
- The problem is that similarity produces multiple **biases**

Representative Bias (1): Insensitivity to Prior Probabilities

- The base rate of outcomes should be a major factor in estimating their frequency
- However, people often ignore it (e.g., there are more farmers than librarians)

Representative Bias (2): Insensitivity to Sample Size

- The size of a sample withdrawn from a population should greatly affect the likelihood of obtaining certain results in it
- People, however, ignore sample size and only use the superficial similarity measures
- For example, people ignore the fact that **larger** samples are **less** likely to deviate from the mean than **smaller** samples

Representative Bias (3): Misconceptions of Chance

- Random patterns appear nonrandom & people may inappropriately attribute a cause for the apparent pattern
- People expect random sequences to be "representatively random" even *locally*
  - E.g., they consider a coin-toss run of HTHTTH to be more likely than HHHTTT or HHHHTH
- Gambler's Fallacy – idea that prior outcomes can influence an independent probabilistic event
  - After a run of reds in a roulette, black will make the overall run more representative (chance as a self-correcting process??)

"The urge to find order in the environment appears to be a rather deep-seated human drive." Herb Simon

Representative Bias (4): Insensitivity to Predictability

- People predict future performance mainly by similarity of description to future results
- For example, predicting future performance as a teacher based on a single practice lesson
  - *Evaluation* percentiles (of the quality of the lesson) were identical to *predicted* percentiles of *5-year future standings* as teachers

Conjunction Fallacy

- Use of representativeness heuristic: we think that people who exhibit certain characteristics will exhibit other, related characteristics
  - we think that "like goes with like"
- Example: People were told that Linda majored in philosophy and was a social activist. Then they ranked the probability of 8 statements about Linda.
  - Linda is a bank teller
  - Linda is a bank teller and a feminist

Conjunction Fallacy

- 80% of people rated the statement "Linda is a bank teller and a feminist" as *more* likely than "Linda is a bank teller"
- This contradicts the fact that the probability of *x* is greater than the probability of *x* and *y* co-occurring (when x and y are independent events)
- When this is pointed out to people, they admit they have made an error

The Availability Heuristic

- The frequency of a class or event is often assessed by the ease with which instances of it can be brought to mind
- The problem is that this mental availability might be affected by factors other than the frequency of the class

Availability Biases (1): Ease of Retrievability

- Classes whose instances are more easily retrievable will seem larger
  - For example, judging if a list of names had more men or women depends on the relative frequency of famous names
- Salience affects retrievability
  - E.g., watching a car accident increases subjective assessment of traffic accidents

Availability Biases (2): Effectiveness of a Search Set

- We often form mental "search sets" to estimate how frequent are members of some class
- But, effectiveness of search set might not relate directly to the class frequency
  - Which is more prevalent: Words that start with *r* or words where *r* is the 3rd letter?
  - Are abstract words such as *love* more frequent than concrete words such as *door*?

Availability Biases (3): Ease of Imaginability

- Instances often need to be constructed on the fly using some rule; the difficulty of imagining instances is used as an estimate of their frequency
- Imaginability might cause overestimation of likelihood of vivid scenarios, and underestimation of the likelihood of difficult-to-imagine ones

Availability Biases (4): Illusory Correlation

- People tended to overestimate co-occurrence of *diagnoses* such as paranoia or suspiciousness with *features* in persons drawn by hypothetical mental patients, such as peculiar eyes
- Subjects might overestimate the correlation due to easier association of suspicion with the eyes than other body parts

A Trip to the Airport

Relativity of Judgment & Use of Norms

- John vs. Jill
  - John can imagine more similar possible worlds where he makes his flight
- Judgments based on comparisons of alternative possible worlds
- Judgments reflect *mutability*
  - Atypical > Typical
  - Foreground > Background

The Anchoring and Adjustment Heuristic

- People often estimate by adjusting an initial value until a final value is reached
- Initial values might be due to the problem presentation or due to partial computations
- Adjustments are typically insufficient and are biased towards initial values, the anchor

Anchoring and Adjustment Biases (1): Insufficient Adjustment

- Anchoring occurs even when initial estimates (e.g., percentage of African nations in the UN) were explicitly made at random by spinning a wheel!
- Anchoring may occur due to incomplete calculation, such as estimating by two high-school student groups
  - the expression 8x7x6x5x4x3x2x1 (median answer: 512)
  - with the expression 1x2x3x4x5x6x7x8 (median answer: 2250)
- Anchoring occurs even with outrageously extreme anchors (Quattrone et al., 1984)
- Anchoring occurs even when experts (real-estate agents) estimate real-estate prices (Northcraft and Neale, 1987)

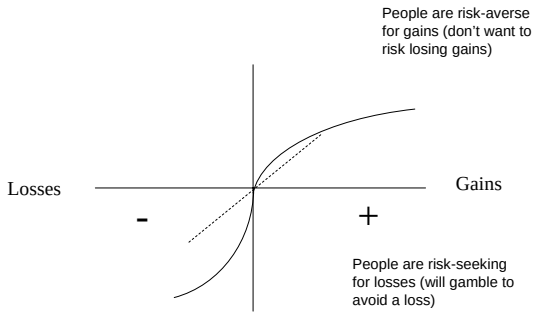
Anchoring/Adjustment Biases (2): Evaluation of Conjunctive and Disjunctive Events

- People tend to overestimate the probability of conjunctive events (e.g., success of a plan that requires success of multiple steps)
- People underestimate the probability of disjunctive events (e.g. the Birthday Paradox)
- In both cases there is insufficient adjustment from the probability of an individual event

A Special Type of Bias: Framing

- Risky prospects can be framed in different ways- as gains or as losses
- Changing the description of a prospect should *not* change decisions, but it *does*, in a way predicted by Tversky and Kahneman's (1979) Prospect Theory
- In Prospect Theory, the negative effect of a *loss* is larger than the positive effect of a *gain*
- Framing a prospect as a loss rather than a gain, by changing the *reference point*, changes the decision by changing the evaluation of the same prospect

A Value Function in Prospect Theory



Summary: Heuristics and Biases

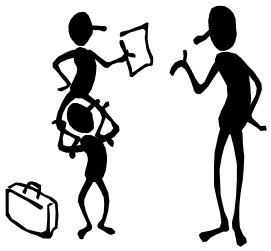
- There are several common heuristics people employ to estimate probabilities
  - **Representativeness** of a class by an object
  - **Availability** of instances as a frequency measure
  - **Adjustment** from an initial **anchoring** value
- All heuristics are quite effective, usually, but lead to predictable, systematic errors and biases
- Understanding biases might decrease their effect

Decision Making and Explanations

- Pennington & Hastie
  - Complex decision making involves construction of explanations
- Legal Judgment Task
  - Varied order of evidence
  - People favored the more easily constructed story
  - Confidence related to existence of competing explanations

Satisficing

- Abandon goal of making optimal choice in favor of one that is satisfactory
- Search alternatives until you find a satisfactory one



Dealing with Complexity

- Elimination of Aspects
  - Pick aspect and threshold
  - Eliminate sub-threshold members
  - Pick next aspect and threshold
  - Eliminate sub-threshold members
  - (Rinse & Repeat)

Elimination of Aspects

	Noisiness	Cleanliness	Distance	Rent
Apt A	Low	Fair	20 min	$410
Apt B	High	Good	30 min	$570

Adaptive Decision Making

- Payne and colleagues
- Simulations
  - Expected Utility
    - Tanks under pressure…
  - Satisficing
  - Elimination of Aspects
    - Performed well under time pressure!
- Experiments
  - Little time pressure: attempt to use optimal strategies
  - Lots of time pressure: use heuristics

Decision Making

- Expected Value Theory does not capture subjective value of many goods
- Expected Utility Theory does not capture subjective understanding of probability
- People often use heuristics to make decisions
  - Anchoring & Adjustment
  - Availability
  - Representativeness
- Use of heuristics can lead to biases & fallacies
  - A&A → Insufficient Adjustment
  - Availability → Hindsight Bias
  - Representativeness → Conjunction Fallacy, Gambler's Fallacy