



- A bat and a ball cost you \$22 as a total. A bat costs \$20 more than a ball. How much is the price of a ball?



- If it takes 5 machines 5 minutes to make 5 t-shirts, how long would it take 100 machines to make 100 t-shirts?



- In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half of the lake?

## Heuristic Judgment

Availability  
Anchoring and Adjustment  
Representativeness

## Heuristics

Tversky and Kahneman (1974) proposed three major heuristics people use in making judgments & decisions

*(Judgment under Uncertainty: Heuristics and Biases, Science, Vol. 185, No.4157, pp.1124-1131)*

- Representativeness
- Availability
- Anchoring & adjustment

## Kahneman and Tversky



[http://nobelprize.org/nobel\\_prizes/economics/laureates/2002/kahneman-autobio.html](http://nobelprize.org/nobel_prizes/economics/laureates/2002/kahneman-autobio.html)  
[http://www.dangoldstein.com/dsn/archives/2005/07/amos\\_tversky\\_1.html](http://www.dangoldstein.com/dsn/archives/2005/07/amos_tversky_1.html)

["Judgment under Uncertainty: Heuristics and Biases," Science, 1974.](#)

## Heuristics

- People rely on a **limited number of heuristic principles** which **reduce the complex tasks** of assessing *probabilities* and *predicting values* to **simpler judgmental operations**.

Heuristic reasoning strategies ....

- .... are often fast and effective,
- .... place low demands on cognitive resources.
- .... but they can lead to severe and systematic errors

## Availability Heuristics

- People assess the frequency of a class or the probability of an event by the ease with which instances or occurrences can be brought to mind.

e.g. What is the risk of cancer among middle-aged people?

<= recalling from family members, relatives, close friends...

## Availability Heuristics

- If certain cases can be **easily retrieved** from memory, then we assume that they are **more frequent**.
- If it's more **difficult to retrieve** examples of something from memory, we assume that **they are rare**.

- Instances with high probabilities, high frequencies are usually recalled faster/better.

But also affected by...

1. Retrievability of Instances
2. Effectiveness of a search set
3. Imaginability
4. Illusory correlation

## Availability

- Unusual or special examples
  - Tend to be more noticeable
  - Be more likely to be stored in memory
  - Be more "available"

⇒Plane crashes  
 ⇒Terrorist attacks  
 ⇒Swine flu

## Use of Availability

- Advertising: the goal is to make your product more available
- Repeated exposure makes something more available, because many examples have been stored in memory



## 1. Retrievalability of Instances

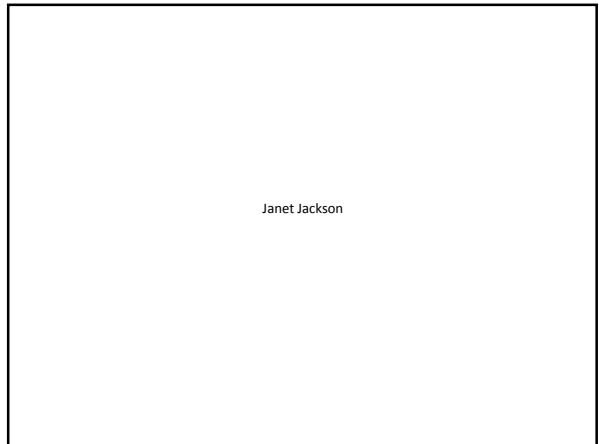
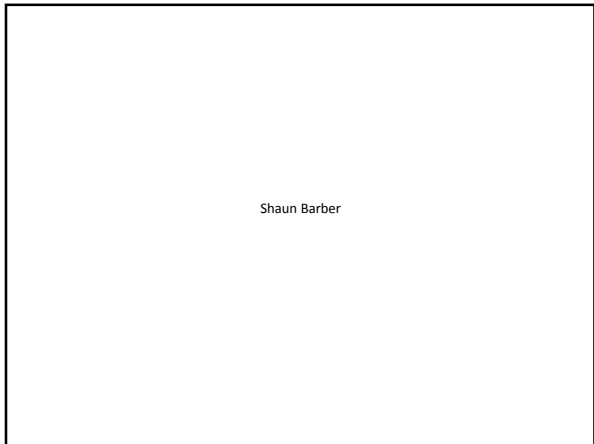
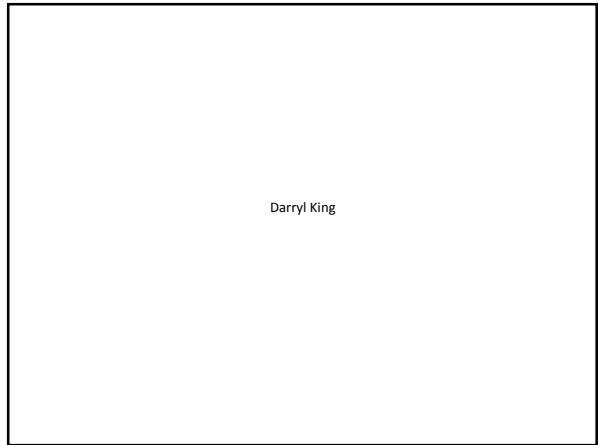
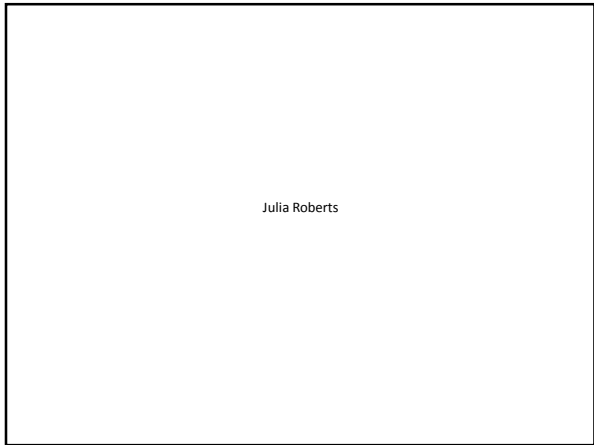
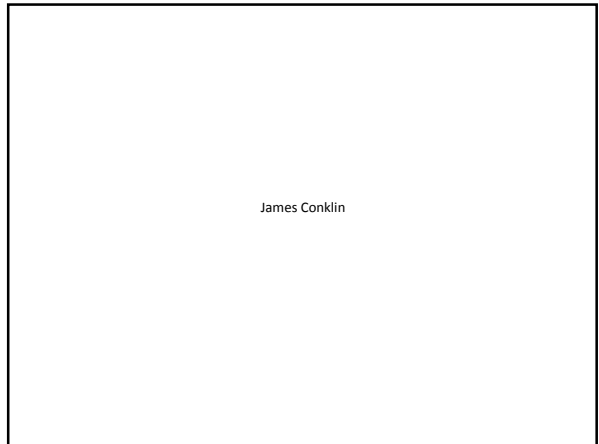
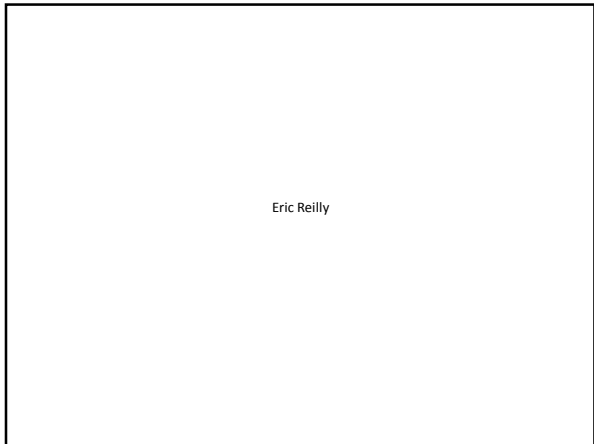
- Familiarity
- Salience

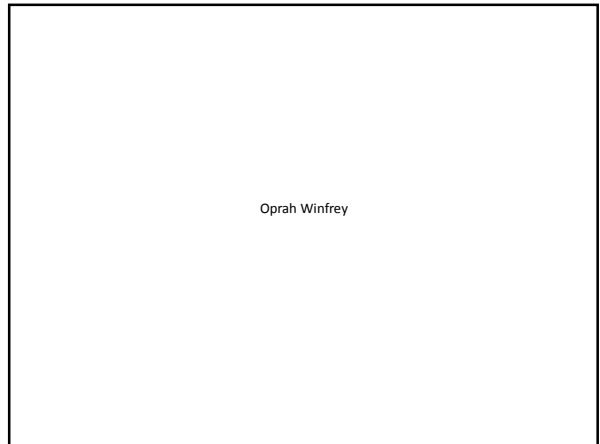
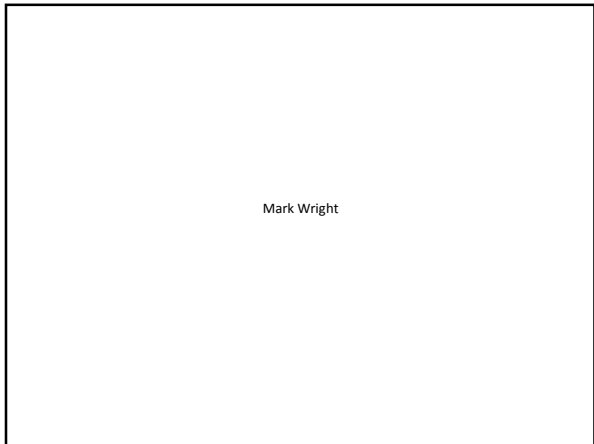
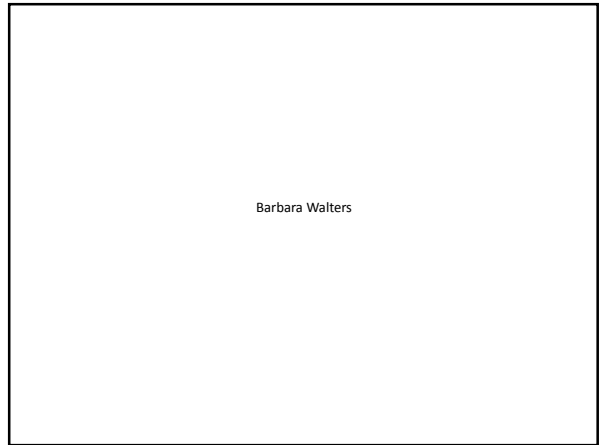
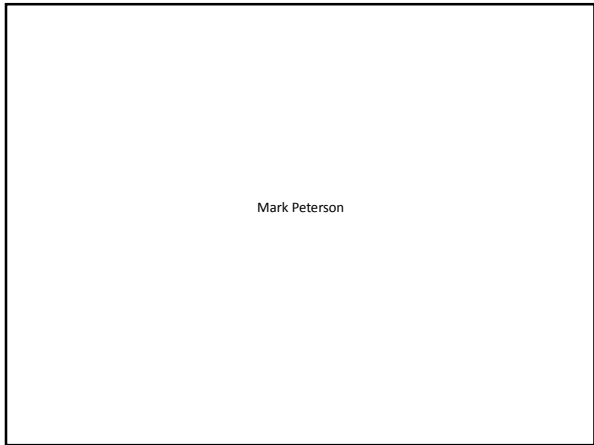
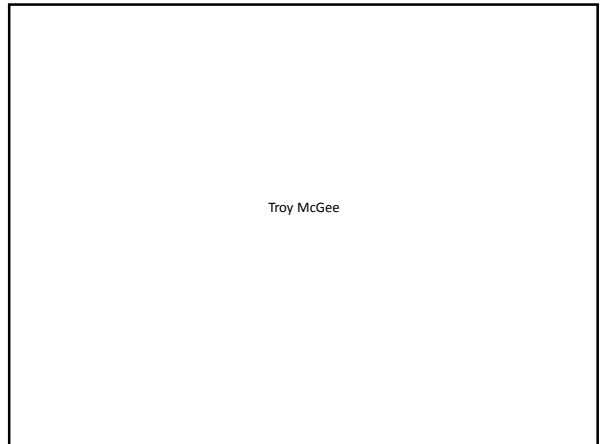
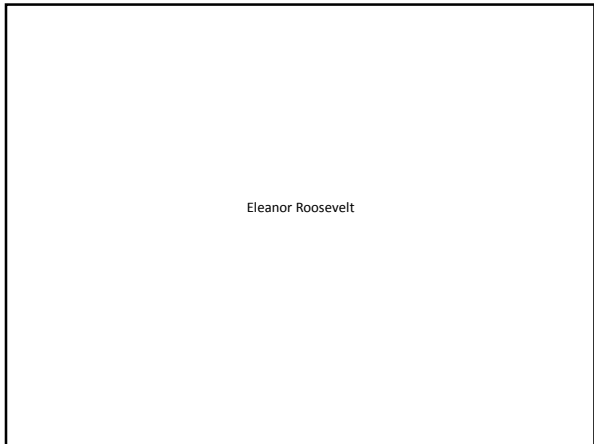
## Experiment:

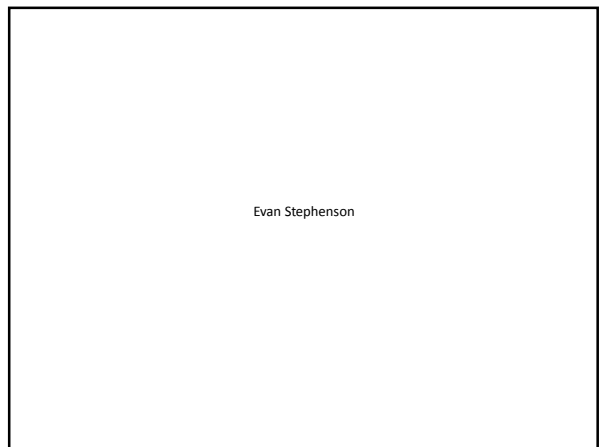
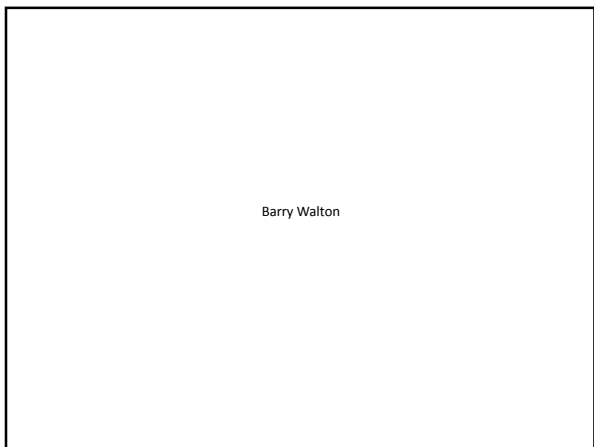
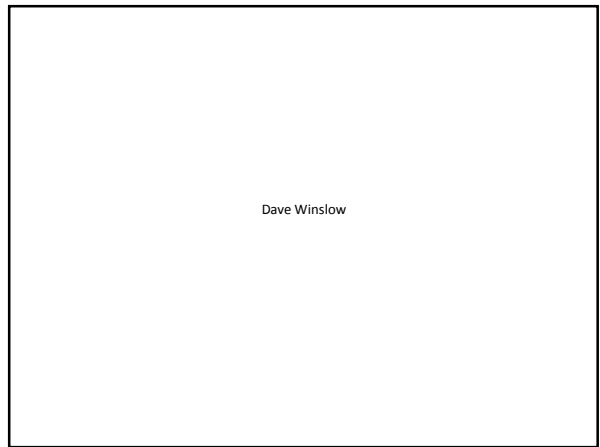
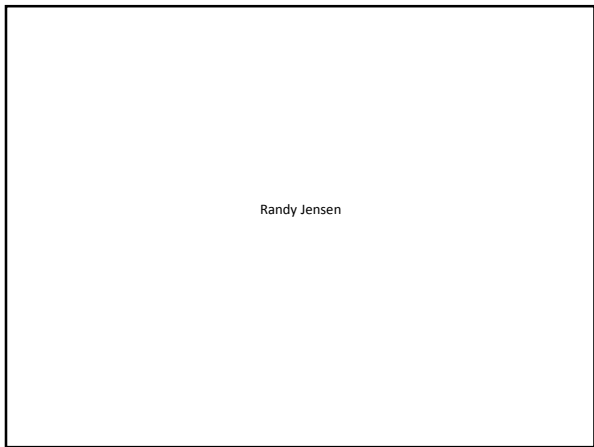
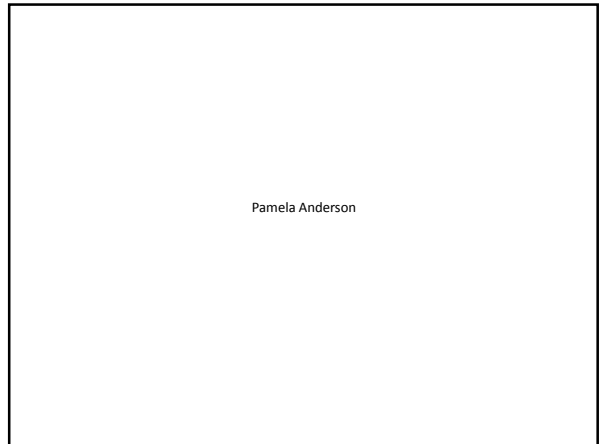
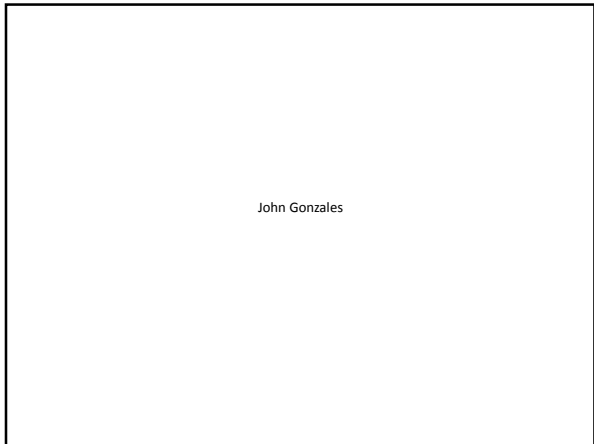
- In this experiment, you will be shown a list of names. You should attend to each name as it appears on the screen in preparation for a later memory test

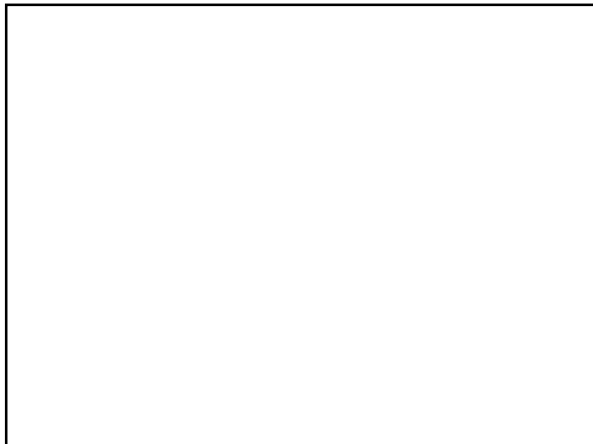
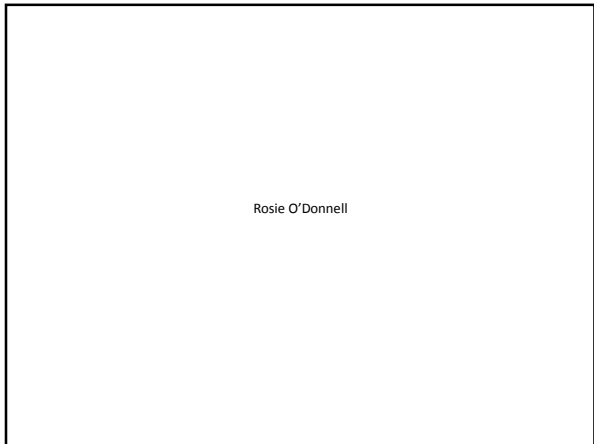
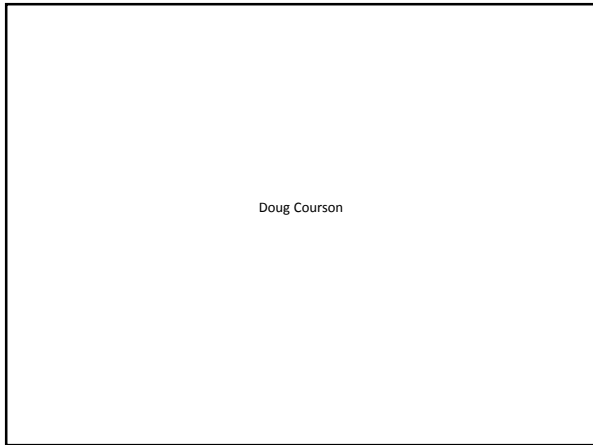
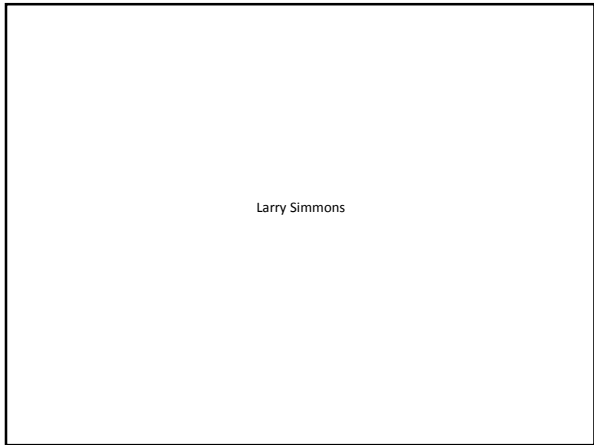
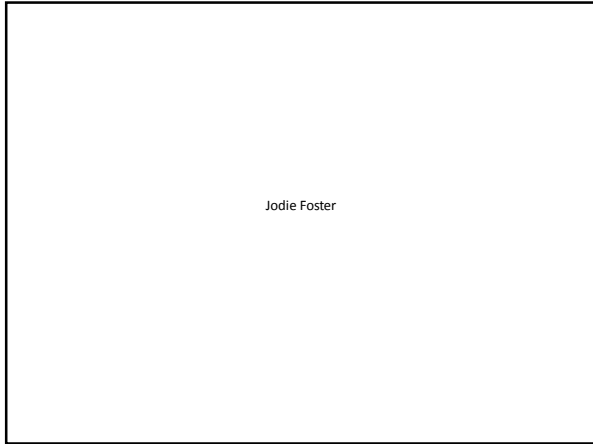
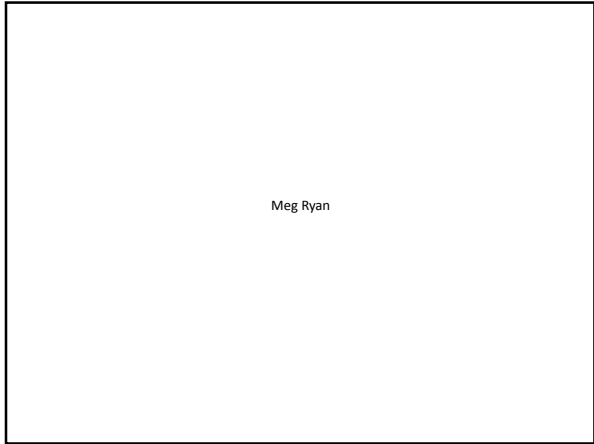
Tim Kirkland

Hillary Clinton









Question:

Does the list contain more names of men than of women?

(15 male, 10 female)

## Examples

- Which is a more likely cause of death in the United States: being killed by falling airplane parts or being killed by a shark?
  - In the United States, the chance of dying from falling airplane parts is 30 times greater than dying from a shark attack.
  - Because shark attacks receive more publicity, information about shark attacks is more readily available.

Which claims more lives in the United States: lightning or tornadoes?

- More Americans are killed annually by lightning than by tornadoes.
- Because tornadoes receive more publicity than occasional lightning strikes, the most common answer is tornadoes.

Which disease are the higher causes of death in Turkey?

Cancer vs. Accidents

Heart Disease vs. Diabetes

[Cancer 21.1%, Accidents 4.1%]

[Heart Disease 37.9%, Endocrine and Metabolic diseases including Diabetes, 6.0%]

Availability about causes of death estimates is determined by media coverage. Tend to overestimate the probability of rare events.

⇒ Shark attacks are more on TV than hit by lightning.

⇒ Hear news on death from traffic accidents, but not from cancer.

## Risk and Insurance

Natural Disaster and Insurance Purchase  
(Howard Kunreuther)

- Large flood -> flood insurance
- Large earthquake -> earthquake insurance, protective actions



- Protective actions are designed to be adequate to the worst disaster **actually experienced** (individuals/government)

⇒ Fukushima nuclear disaster

Tsunami hit the power plant was “bigger” than it was assumed when the design of the power plant was made.

⇒ Difficult to take preventive cares (tests for disease, stop smoking ...) before actually “bad effect” is experienced.

## 2. Effectiveness of a search set

- We often form mental “**search sets**” to estimate how frequent are members of some class; the effectiveness of the search might not relate directly to the class frequency
  - Which are more prevalent?: Words that start with *r* or words where *r* is the 3<sup>rd</sup> letter?

## Example: Military

- The effectiveness of our search set has a big impact on operations in Iraq and Afghanistan. When observing IED strikes and ambushes along routes, we typically search those routes repeatedly for high value targets, yet our operations rarely find them. Our search set is mentally constrained to the map of strikes we observe on the charts in our operation centers. We should look for our adversaries in areas where there are no IEDs or ambushes. They may be more likely to hide there.
- (Source: “Heuristics and Biases in Military Decision Making” Major Blair S. Williams, U.S. Army)

## 3. Imaginability

- Sometimes one has to evaluate the probabilities of the events whose instances are not stored in memory but can be generated according to a given rule.
- When confronted with a situation without any available memory, we use our imagination to make a subjective premonition.
- **How easy it is to construct contingent cases determines the frequencies of the event.**

## Example: Expedition

- Evaluation of risk involved in an expedition (climbing Himalaya, heading to north pole, deep sea excavation etc.)
- Risk is evaluated by imagining contingencies.
  - If the difficulties are vividly portrayed, it seems to be extremely dangerous.
  - If the difficulties are either difficult to conceive or don’t come to mind, the risk is likely to be underestimated.

## 4. Illusory Correlation

- Judgment of the frequency with which two events co-occur.
- The phenomenon of perceiving a relationship between variables even when no such relationship exists.

### Examples...

- A worker is treated poorly by a person of a specific ethnicity. The worker then chooses to never work for a person of that ethnicity again, relating the person's behavior to his ethnicity.
- A woman is interviewing for jobs. She believes she gets a better response from potential employers when she wears a specific pair of earrings, so she wears those earrings to every interview.
- A student does well on a test when he uses his blue pencil. For all future tests he uses only his blue pencil.

### Problem with “Causation”

- Statistic/Econometric analysis do not prove any “causation”.

e.g. Cause – Effect ?

A: The number of hours a kid play “violent” video games.

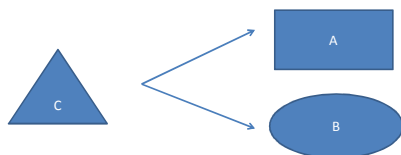
B: Crime committed by a kid.



e.g. Cause – Effect ?

A: The number of hours a kid play “violent” video games.

B: Crime committed by a kid.



### Anchoring and Adjustment

- People make estimates by starting from an initial value that is adjusted to yield the final answer.
- The initial value (=starting point) may be suggested by the formulation of the problem (sometimes not at all related to the main problem.)

### Types of “Anchoring and Adjustment”

1. Insufficient Adjustment
2. Biases in the evaluation of conjunctive and disjunctive events
3. Anchoring in the assessment of subjective probability distributions

### 1. Insufficient Adjustment

- A cognitive process whereby decision makers first focus on the anchor and then make a series of dynamic adjustments toward their final estimate.
- Because these adjustments are insufficient, the final answer is biased toward the anchor.



- Housing price example

Suggested price of this house is 1,000,000 TL. How much are you willing to pay?



Suggested price of this house is 500,000 TL. How much are you willing to pay?



- The same house will appear more valuable if its listing price is high than if it is low.

Example: Environmental Evaluation Study

Q1: Would you be willing to pay \$5 to save 50,000 offshore pacific coast seabirds from small offshore oil spills?

Q2: How much are you willing to pay to save 50,000 offshore pacific coast seabirds from small offshore oil spills?

Estimate of mean WTP from Q1: \$20.

Estimate of mean WTP from Q2: \$64.

ORGANIZATIONAL BEHAVIOR AND HUMAN DECISION PROCESSES 39, 84-97 (1987)

**Experts, Amateurs, and Real Estate: An Anchoring-and-Adjustment Perspective on Property Pricing Decisions**

GREGORY B. NORTHCRAFT AND MARGARET A. NEALE

- Actual price of a house: \$74,900

Anchors: List Price

Low-\$65900 (-12%)

Moderately Low - \$71900 (-4%)

Moderately High - \$77900 (+4%)

High-\$83900 (+12%)

Amateur vs. Experts

(Undergraduate students vs. Real Estate Agents)

**Amateur Responses**

TABLE 1  
RESULTS FOR EXPERIMENT 1, HYPOTHESIS 1: MEAN ESTIMATES OF AMATEUR SUBJECTS (n = 48)

	Appraisal value	Listing price	Purchase price	Lowest offer
Listing price				
\$ 65,900	\$ 63,571	\$ 69,414	\$ 63,571	\$ 62,571
71,900	67,452	72,328	67,581	66,928
77,900	70,423	75,776	70,069	70,107
83,900	72,196	78,014	69,500	69,785

Actual price of a house: \$74,900

**Experts Responses**

TABLE 2  
RESULTS FOR EXPERIMENT 1, HYPOTHESIS 1: MEAN ESTIMATES OF EXPERT SUBJECTS (n = 21)

	Appraisal value	Listing price	Purchase price	Lowest offer
Listing price				
\$ 65,900	\$ 67,811	\$ 69,966	\$ 66,755	\$ 65,000
83,900	75,190	76,380	73,000	72,590

Actual price of a house: \$74,900

Journal of Marketing Research  
Vol. XXXV (February 1998), 71-81

**An Anchoring and Adjustment Model of Purchase Quantity Decisions**

BRIAN WANSINK, ROBERT J. KENT, and STEPHEN J. HOCH\*

**Study 1: Multiple-unit pricing**

Product	Form of Price Expression	Percentage Change in Unit Sales		p-Value
		Single unit	Multiple unit	
Bathroom Tissue	1/50¢ versus 4/\$2.00	+57	+97	.02
Candy	1/50¢ versus 2/\$1.00	+24	+25	n.s.
Cereal (Breakfast)	1/\$1.99 versus 2/\$3.98	+133	+137	n.s.
Cookies	1/\$1.67 versus 2/\$3.34	+306	+372	.01
Frozen Dinners	1/\$2.49 versus 2/\$5.00	+33	+70	.003
Frozen Dinners	1/\$2.50 versus 2/\$5.00	+133	+195	.0001
Frozen Entrees	1/\$1.25 versus 2/\$2.50	+133	+156	.02
Paper Towels	1/75¢ versus 2/\$1.50	+403	+565	.001
Soap (3-Bar Packs)	1/\$1.99 versus 2/\$3.98	+48	+30	n.s.
Soft Drinks (2 Liters)	1/\$1.49 versus 2/\$3.00	+33	+66	.01
Soup (Canned)	1/\$1.33 versus 2/\$4.00	+200	+248	.01
Soup (Canned)	1/50¢ versus 2/\$1.00	+108	+112	n.s.
Tuna (Canned)	1/65¢ versus 2/\$1.30	+36	+66	.004
		+125%	+165%	.0001

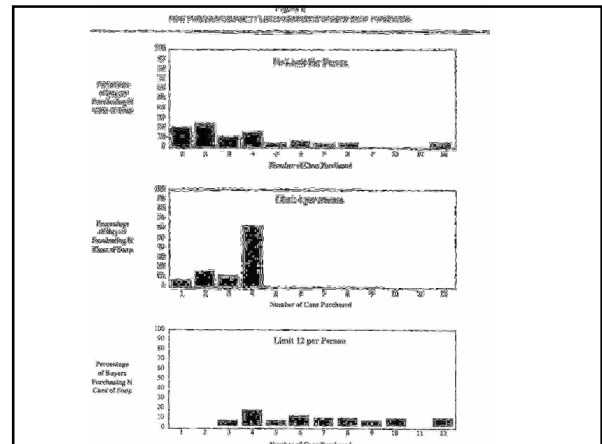
The quantity listed in multiple-unit pricing (4/\$2.00) provides an anchor, 4.

## Study 2: Quantity Limits

THE IMPACT OF PURCHASE QUANTITY LIMITS ON SUPERMARKET SALES

Measure	Quantity Limit Level		
	No Limit	Limit 4	Limit 12
Purchase Quantity per Buyer	3.3 <sup>a</sup>	3.5 <sup>a</sup>	7.0 <sup>b</sup>
Purchase Incidence	7%	10%	9%
Total Units Sold	73 <sup>a</sup>	106 <sup>a</sup>	188 <sup>b</sup>

Quantity limit itself serves as an anchor. The larger the limit is (12 vs. 4), the larger the increase in the amount of purchase.



### Example: Impacts of absurd anchors

- Example: Suppose a biased or unreliable news source tells you that something extreme will happen, e.g, next year 50% of retail banks will fail.
  - You don't trust this news source, so you adjust the estimate from 50% to something you think is more realistic, but your adjustment will typically be too small.
- Example: People anchor on their own opinions and values and then adjust to take into account other people's differences (anchoring on ourselves).
- Consequence: We tend to expect others to be more like ourselves than they are.

### More examples..

- Gandhi example

#### 1<sup>st</sup> group:

- Gandhi was more than 144 years old when he died. Correct or not. If not, how old was he?

#### 2<sup>nd</sup> group:

- Gandhi was 35 years old when he died. Correct or not. If not, how old was he?

- Whatever information is available, even if the quantity of the information is slight, its quality is poor, and it is completely unrealistic, absurd or even a lie, your judgment is affected.
- Our thoughts and our behavior are influenced, much more than we know or want, by the environment of the moment.

- People adjust less when their mental resources are depleted, either because their memory is loaded with digits or because they are slightly drunk.