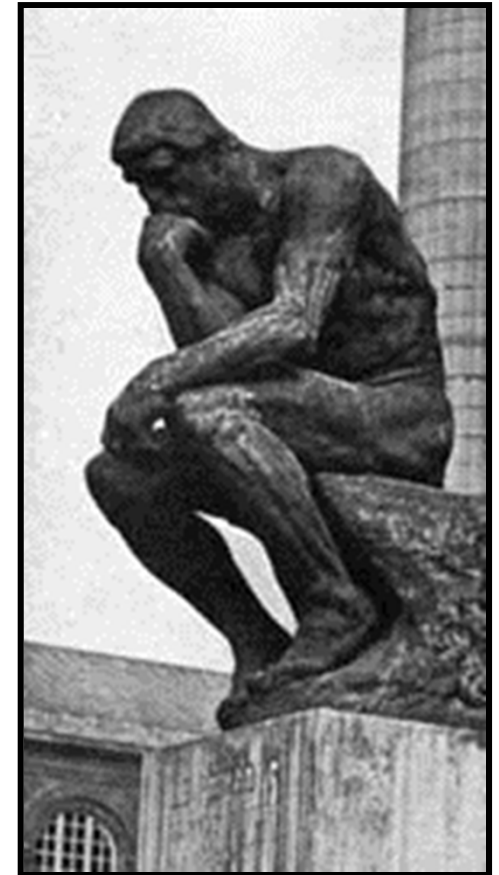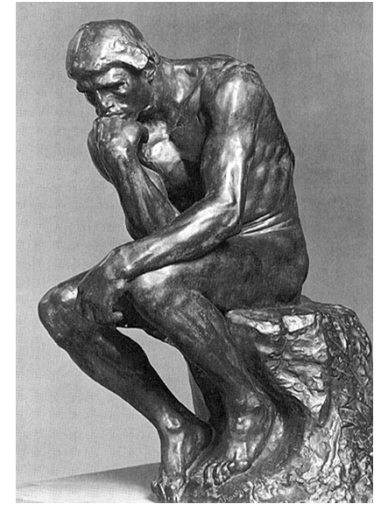# Thinking

- ❑ Definition & Types of Thinking.
- ❑ Big Questions & Two Strategies.
  - ❑ Judgment.
  - ❑ Reasoning.
  - ❑ Decision-Making.
  - ❑ Problem Solving.
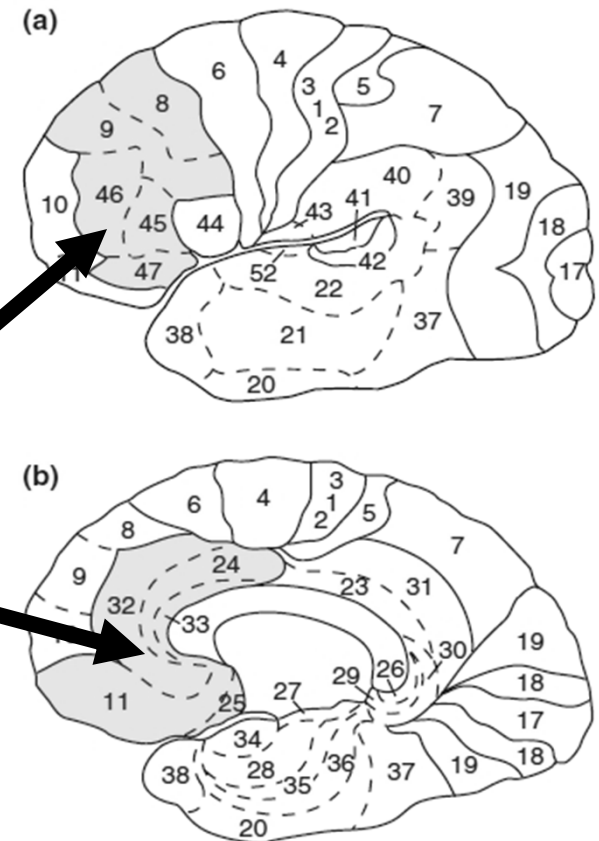
Thinking is...

- the **manipulation of information** or **creation of new information**, usually to reach a goal.

- **heavily dependent on working memory** and the **frontal lobes** (esp. the *dorsolateral PFC,* & the *ventromedial PFC*.

Different Kinds of Thinking

1. *Judgment (cf. Induction):* **Estimating odds, drawing inferences, & making predictions.**

2. *Reasoning (cf. Deduction):* **Evaluating the implications of what you know; drawing conclusions based on premises.**

3. *Decision Making:* **Selecting among *choices* that involve some *risk or uncertainty*.**

4. *Problem solving:* **The process of transforming an initial (problem) state into some goal state (solution).**

Induction & Deduction
reaching a conclusion based on evidence

- **Judgment is generally <u>Inductive</u> - from specific observations or facts to general claims.**
  - "*the sky is overcast, so it's probably going to rain*".
  - "*he looks over here a lot, so he probably likes me*".
  - <u>Induction is probabilistic</u> - not certain, only more or less likely.

- **Reasoning is generally <u>Deductive</u> - from general facts ("premises") to specific conclusions.**
  - "*If the glove doesn't fit, you've got to acquit*".
  - *All students love to party. Pat is a student. Therefore, Pat loves to party.*
  - Deduction is <u>certain</u> ("logical"), given that the premises are true (but that is not always the case).

Big Questions about Thinking

1. Are people rational?

   - In what ways are people not rational, and why?
   - Under what circumstances are people not rational?
   - Can thinking (rationality) be improved with training?

2. Does reason involve emotion?

   - Are emotions irrational, or do they 'inform' reason?
   - How are reason & emotion integrated in the brain?

3. Is thinking conscious?

   - How do *un*conscious processes affect thinking?
   - What does consciousness add to thinking?

Are people rational?

The history of thinking about thinking has been organized around the idea that human decision-making is optimal or rational (called a __normative account__ - how we __ought__ to think).

A major contribution of psych has been to show that thinking often departs from perfect rationality (called a __descriptive account__ - how we __do__ think).
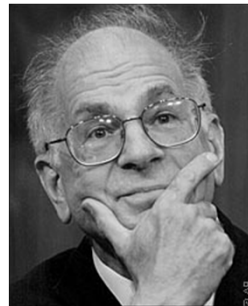
Amos Tversky   Daniel Kahneman

Kahneman won a Nobel prize "for having integrated insights from psychological research into economic science, especially concerning human judgment and decision making under uncertainty".
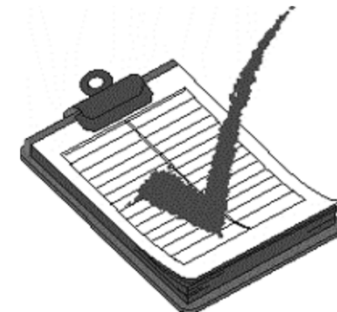
Are people rational?

Rationality: **Considering all relevant info & options; examining evidence that both supports and conflicts with your conclusions.**

Class question: **Are you capable of making** <u>rational</u> **judgments and decisions?**

➤ <u>Yes:</u> **E.G...** • **examining all possible moves in chess.**

• **exhaustive pros & cons checklist of all graduate schools you could attend.**

Algorithm: Specific rules or procedures that *guarantee* a good solution.

Are people *always* rational?

➢ **No:** There are drawbacks to using algorithms.

1. Efficiency: There isn't always time to use an algorithm.

   ➢ *"Cognitive Overload"*

2. An appropriate algorithm is not always clear.

   ➢ *Getting a date with someone you have a crush on.*

Heuristics: short-cuts or "rules of thumb" that are fast and easy but which *do not* guarantee a good solution.

Judgment Heuristics

❑ **The Availability Heuristic**

- **Biases in judgments about frequency, probability, & causality.**

- **Anchoring & Adjustment.**

❑ **The Representativeness Heuristic**

- **Gambler's fallacy.**

- **Conjunction fallacy.**

- **The role of baserates in judgment.**

The Availability Heuristic

- *Which is the more common pet among UNCW students, cats or dogs?*

- *Are there more words beginning with "r" or more words with "r" in the third position?*

- *Are there more words ending in "-ing" or more words having "n" in the second-to-last position?*

- <u>The availability heuristic</u>: Making a decision based on the ease with which relevant information comes to mind.

The Availability Heuristic

❑ *Which of the following is more frequent?*

Cause of death in the US...

- Homicide or Diabetes?

Cause of fatal auto accidents...

- Running stop light/sign or driving left of center line?

❑ **Probability**

Is a randomly selected UNCW faculty member more likely to be male or female?

❑ **Causality**

Why do men suffer more heart attacks than women?

What Factors Increase Availability?

❑ *What is the basis of availability?*

- **Retrieval from memory**

❑ *If memory is the basis of availability, what factors should affect availability?*

- **Priming.**

- **Primacy & Recency.**

- **Distinctiveness, organization, elaboration, imagery, emotional interest, etc.**

- **Encoding Specificity.**

The Availability Heuristic

➢ **An example of availability based on the distinctiveness of memory:**

Tversky & Kahneman:

→ **Ss hear a list of 38 names, 19 male and 19 female.**

→ **For one type of list, the female names were famous but not the male names, while in another list type the male names were famous.**

→ **Later, Ss are asked to judge the number of males and females.**

Anchoring and Adjustment

➢ **Quickly estimate the answer to the following multiplication problem:**

1 x 2 x 3 x 4 x 5 x 6 x 7 x 8 = ?   **[Avg est. = 512]**

8 x 7 x 6 x 5 x 4 x 3 x 2 x 1 = ?   **[Avg est. = 2,250]**

[Correct Answer = 40,320]

▪ **Strategy of starting with some initial estimate as an "anchor" and then adjusting subsequent estimates/answers in light of this reference point.**

Anchoring and Adjustment

Tversky & Kahneman (1974):

→ **Ss asked to estimate the percentage of African countries in the United Nations, but first watch the spin of a "random" wheel (1 – 100).**

→ **When the wheel stopped on 10, Ss guessed 25%.**

→ **When the wheel stopped on 65, Ss guessed 45%.**

Anchoring and Adjustment

THE EFFECTS OF ANCHORING ON REAL ESTATE PRICES

Apparent Listing Price, $	MEAN ESTIMATES GIVEN BY REAL ESTATE AGENTS			
	Appraised Value, $	Recommended Selling Price, $	Reasonable Purchase Price, $	Lowest Offer, $
119,900	114,204	117,745	111,454	111,136
129,900	126,772	127,836	123,209	122,254
139,900	125,041	128,530	124,653	121,884
149,900	128,754	130,981	127,318	123,818

Note: This table is adapted from a study by Gregory Northcraft and Margaret Neale (1987).

➢ **Most agents claimed that they'd notice a 5% deviation in listing price, but manipulations of 12% went unnoticed, and influenced judgments.**

The Representativeness Heuristic

→ **For the next 6 babies born in the US, which of the following sequences is most likely?**

BBBBBB   or   GGGBBB   or   GBBGGB

According to the laws of probability, all three are equally likely (but the last one looks more random).

→ **Which event is more likely to happen?**
1. **A man under 55 has a heart attack.**
2. **A man has a heart attack.**
3. **A man that smokes has a heart attack.**
4. **A man who is over 55 & smokes has a heart attack.**

The Representativeness Heuristic

The tendency to judge the probability of an event in terms of its resemblance or similarity to the population from which it is drawn.

→ You watch a fair coin come up heads 5 times in a row. *If you bet $10 on the next toss, do you bet heads or tails?*

➢ *The gambler's fallacy:* The false belief that random processes (coin flips, roulette wheels, etc.) are sensitive to prior outcomes.

The Representativeness Heuristic

→ **Ellen is 31, single, and outspoken. She majored in philosophy, is deeply concerned with issues of discrimination and social justice, has participated in nuclear demonstrations.**

Is Ellen a bank teller or a feminist bank teller?

❑ *The conjunction fallacy:* **The tendency to judge a conjunction of two events as more probable than either event alone.**

Feminist Bank Tellers

Bank Tellers   Feminists
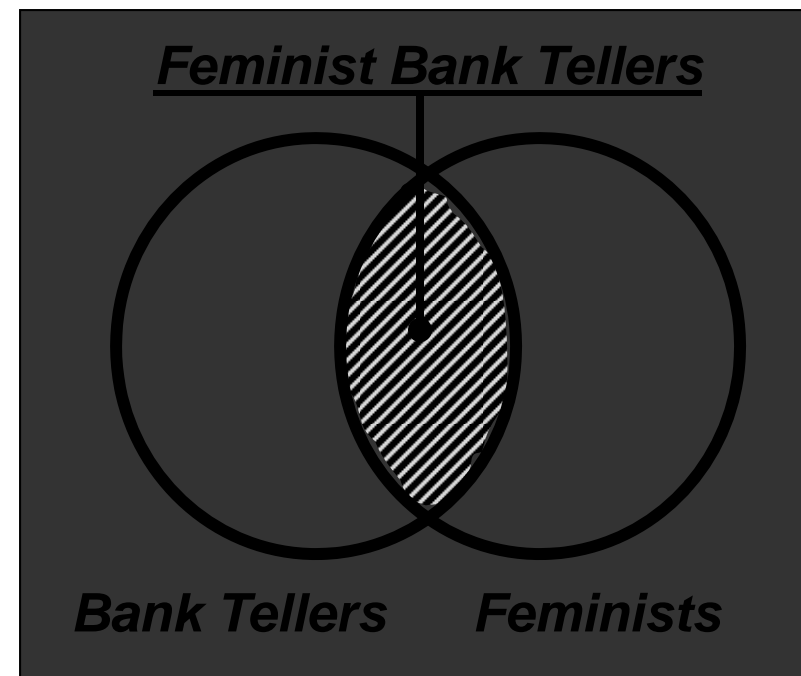
The Representativeness Heuristic

→ Steve is shy and withdrawn, ususally helpful, but with little interest in people. Meek and tidy, he loves order and structure and has a passion for detail. *Is Steve a librarian or a farmer?*

• There are about 400,000 farmers in the US but only 4500 librarians.

Choosing "librarian" suggest a failure to take into account Base Rate - the overall likelihood of a particular event.

The role of Base Rates in Judgment

Description is stereotypical of...

Person...		Librarian	other	
	Librarian	80%	20%	100%
	Farmer	1%	99%	100%

description combined with base rate info...

Description is stereotypical of...

Person...		Librarian	other	
	Librarian	3,600	900	4,500
	Farmer	4,000	396,000	400,000

- *Steve is most likely a farmer.*

The role of Base Rates in Judgment

Mammography accuracy expressed as a %

Mammogram...

Cancer...		positive	negative	
	Present	85%	15%	100%
	Absent	10%	90%	100%

% accuracy combined with base rate info

Mammogram...

Cancer...		positive	negative	
	Present	850	150	1000
	Absent	9,900	89,100	99,000

p(cancer | + mamm.) = 850/(850+9900) = 8%

Detecting Covariation

- *Is it going to rain today?*

- *Does drinking wine at night give you a headache the next morning?*

- *Does aspirin before bed prevent hangovers?*

- *Am I more popular when I wear nice (or trendy, or skimpy) clothes?*

- *Are women more moody than men?*

- *Are old people (or females, or {fill in your favorite stereotype here}) the worse drivers?*

Detecting Covariation

Does knowing one feature allow you to predict other features?

➢ **Yes,** *to the degree they are truly related*:

I know a person who is 6' 9"....

(a) is this person a man or a woman?
(b) are they above or below average weight?

I know a person who loves the WWE...

(a) is this person a man or a woman?
(b) are they passive or aggressive?

Illusions of Covariation

Rorschach (ink blot)

FIGURE 12.10 A case of dissociation of hostile impulses.

FIGURE 12.8 An exhibitionist's drawing

Draw-A-Person Test

Chapman & Chapman (1971) gave people <u>random pairings </u>of Rorschach responses & personality types, and asked if they could detect any relation between the two. Subjects reported finding such relations (e.g., seeing buttocks & homosexuality; drawing pointy-hands & aggression) although there was no real relation.

People (including psychologists!) often find links between test responses & specific personality traits when none truly exist.

Illusions of Covariation

➤ **What factors lead people to create (or experience) illusions of covariation?**

- **Personal Theories:** Thinking that specific relations exist or have been "proven" (which then drives selective attention, and selective sampling of data).

- **Selective Attention:** Actively looking for a specific relation between two variables (even when no "significant" relation exists).

- **Confirmation Bias:** The tendency to seek info that confirms rather than disconfirms your hypothesis (or preconception).

- **Biased Interpretation:** Explaining disconfirmations in terms of luck or special circumstances.

Illusions of Covariation

➢ **Does knowledge help?**
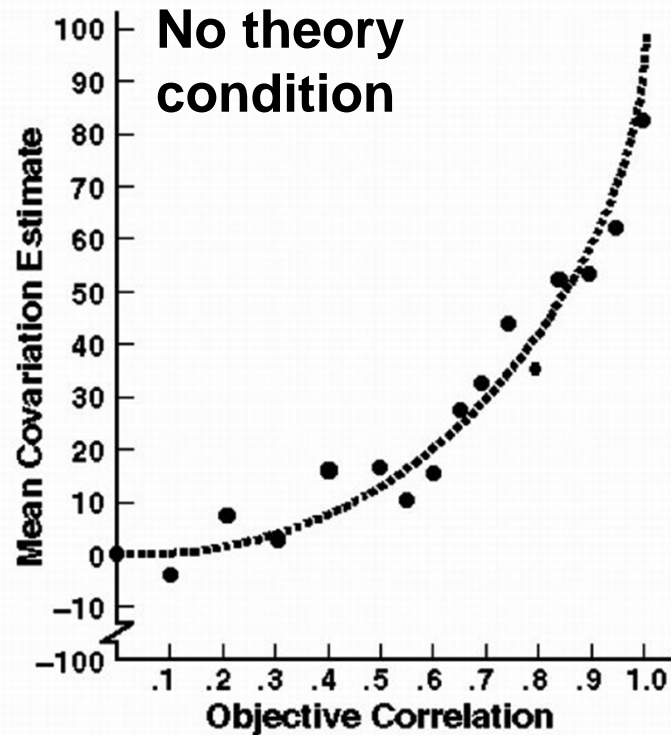
When we have data and no theory, our estimates are quite <u>accurate</u>.
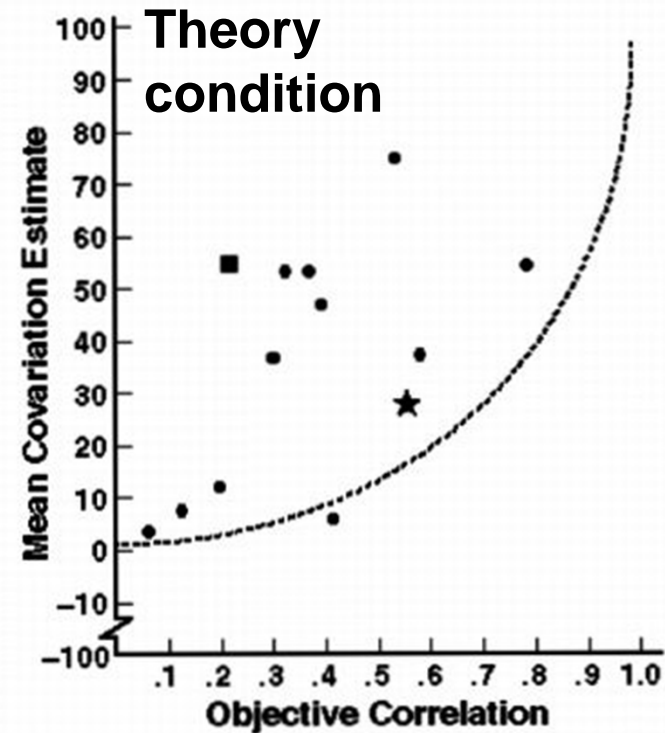
When we have a "theory", our estimates can be very <u>inaccurate</u>.

Does Training Help?

- **People with statistical training make better (more normative) judgments than do those without such training.**

- **Students in social sciences (including *Psychology*!) do better than students in the natural sciences.**
    - *problems related to sample size & variance.*

- **Seniors do better than freshman.**
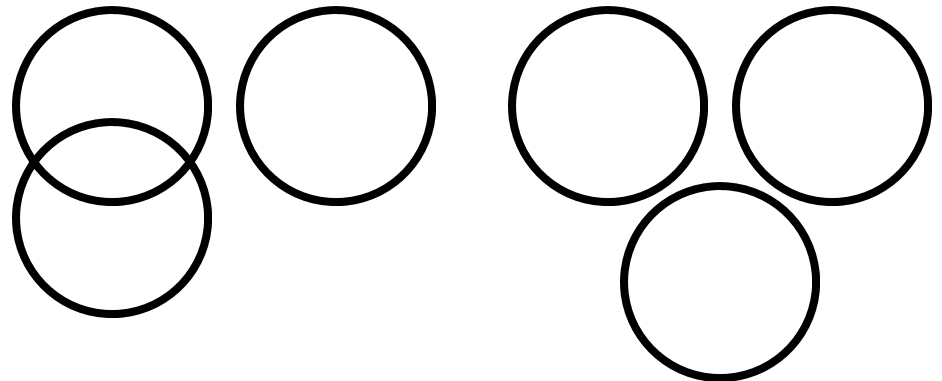   - *more training = better performance.*

Logical Reasoning

➢ *Categorical Syllogism - A logical argument using the quantifiers All, Some, or None.*

- **Some A's are B's.**
- **Some B's are C's.**
  Thus, Some A's are C's.
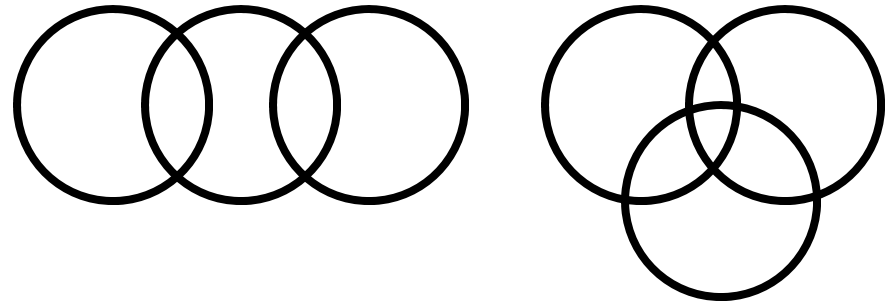
- **No A's are B's.**
- **No B's are C's.**
  Thus, No A's are C's.

➢ ***The Atmosphere effect*** *- Acceptance of a conclusion if its quantifier agrees with those used in the premises.*

Logical Reasoning

➢ *Does use of more concrete premises help?*

- Some rich people are Republicans.
- Some Republicans live in mansions. *Valid or <u>invalid</u>?*
  Thus, some rich people live in mansions.

- All poodles are animals.
- All animals are wild. *<u>Valid</u> or invalid?*
  Thus, all poodles are wild.

➢ *<u>Belief Bias</u> - The tendency to evaluate a logical argument on the basis of whether or not you believe its conclusion.*

Logical Reasoning

➢ *Conditional (propositional) Reasoning.*

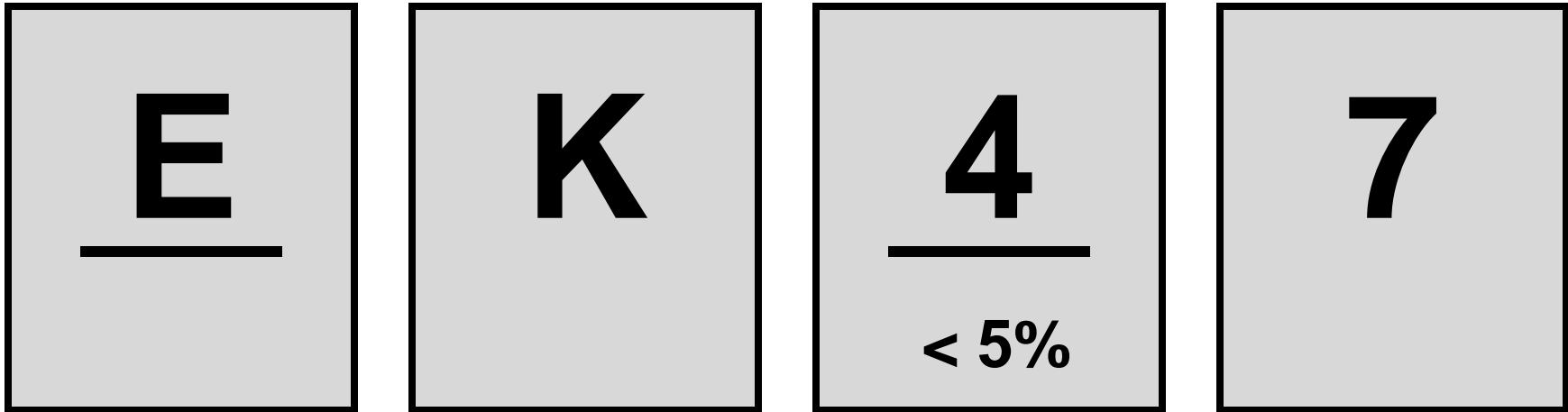|	Modus Ponens	Modus Tollens
VALID	• If P then Q. • P. 　Thus, Q.	• If P then Q. • Not Q. 　Thus, Not P.
INVALID	Affirming the Consequent • If P then Q. • Q. 　Thus, P.	Denying the Antecedent • If P then Q. • Not P. 　Thus, Not Q.

To see for yourself, try P = I've won the lottery & Q = I'm rich.

Logical Reasoning

➢ *Wason's four-card problem.*

| E | K | 4
 ───
 < 5% | 7 |

➢ *The Rule: If there's a vowel one side, then there's an odd number on the other side.*

➢ *Which cards do you need to turn over to verify the rule?*

Logical Reasoning

➢ *Wason's four-card problem made concrete.*

person A	person B	person C	person D
age = 18 drink = ???	age = ?? drink = tea	age = 25 drink = ???	age = ?? drink = beer

➢ *The Rule: If a person's under 21, then they must be drinking a non-alcoholic beverage.*

➢ *Which people do you need to check to verify the rule?*

Confirmation Bias

➢ *Consider the sequence 2 ... 4 ... 6.*

➢ *Your task is to discover the rule underlying this sequence by generating other sequences and getting feedback as to whether or not they fit the rule.*

➢ *Confirmation Bias - The tendency to seek info that confirms rather than disconfirms your hypothesis (or preconception).*

Belief Perseverance

➢ *Ross et al. (1975). S's are shown a series of suicide notes and told to figure our which ones are real and which are fake.*

➢ *On each trial, subjects are given pre-determined, non-contingent feedback about their accuracy (+ or -).*

➢ *After the task, subjects told the feedback was bogus.*

➢ *Nevertheless, those receiving positive feedback rated themselves as more "socially sensitive" and better able to judge things like suicide notes.*

➢ *Belief Perseverance - Believing something, even when shown disconfirming evidence.*

Decision Making

Value & Expected Value

- **<u>Value</u> - the monetary worth of something.**

- **<u>Expected Value</u> - the value of a course of action, given it's probability of occurring.**

- **Example: Bet on the roll of fair die; win $10 for an odd number, $0 for an even number.**
  How much should you bet?

  <u>Expected value</u> **= (1/6)($10) + (1/6)($10) + (1/6)($10) + (1/6)($0) + (1/6)($0) + (1/6)($0) = $5.**

Decision Making

Subjective Utility & Expected Utility

- **Subjective Utility** - the worth of something to a person, measured in terms of happiness, pleasures, satisfaction, etc.

- **Expected Utility (EU) = (utility of an outcome) x (probability of it occurring).**

Decision Making

Multiattribute Expected Utility

Item	Nutrition (5)	Cost (2)	Taste (9)	E.U.
Hamburger	4	9	5	83
Big Mac	3	3	10	111
Filet-O-Fish	6	4	6	92
Grilled Chick.	5	4	8	105
Garden Salad	9	5	2	78

Is this the way you decide what to eat?

Decision Making: Framing

Imagine that the US is preparing for the outbreak of an unusual Asian disease that is expected to kill 600 people. Two alternative programs to combat the disease have been proposed with the following consequences...

- If Program A is adopted, 200 people will be saved.

- If Program B is adopted, there's a .33 chance that 600 people will be saved, and a .67 chance that no people will be saved.

Decision Making: Framing

Imagine that the US is preparing for the outbreak of an unusual Asian disease that is expected to kill 600 people. Two alternative programs to combat the disease have been proposed with the following consequences...

- If Program A is adopted, 400 people will die.

- If Program B is adopted, there's a .33 chance that no people will die, and a .67 chance that 600 people will die.

Decision Making: Framing

Why are we affected by the frame?

➢ People are *risk averse* when decisions are framed in terms of gains.

➢ People are *risk seeking* when decisions are framed in terms of losses.

• More generally, people are more sensitive to losses than they are to gains, a phenomenon known as *loss aversion*.

• Loss aversion may explain *sunk-cost effects* - the tendency to expend additional resources ($) when resources have already been spent.
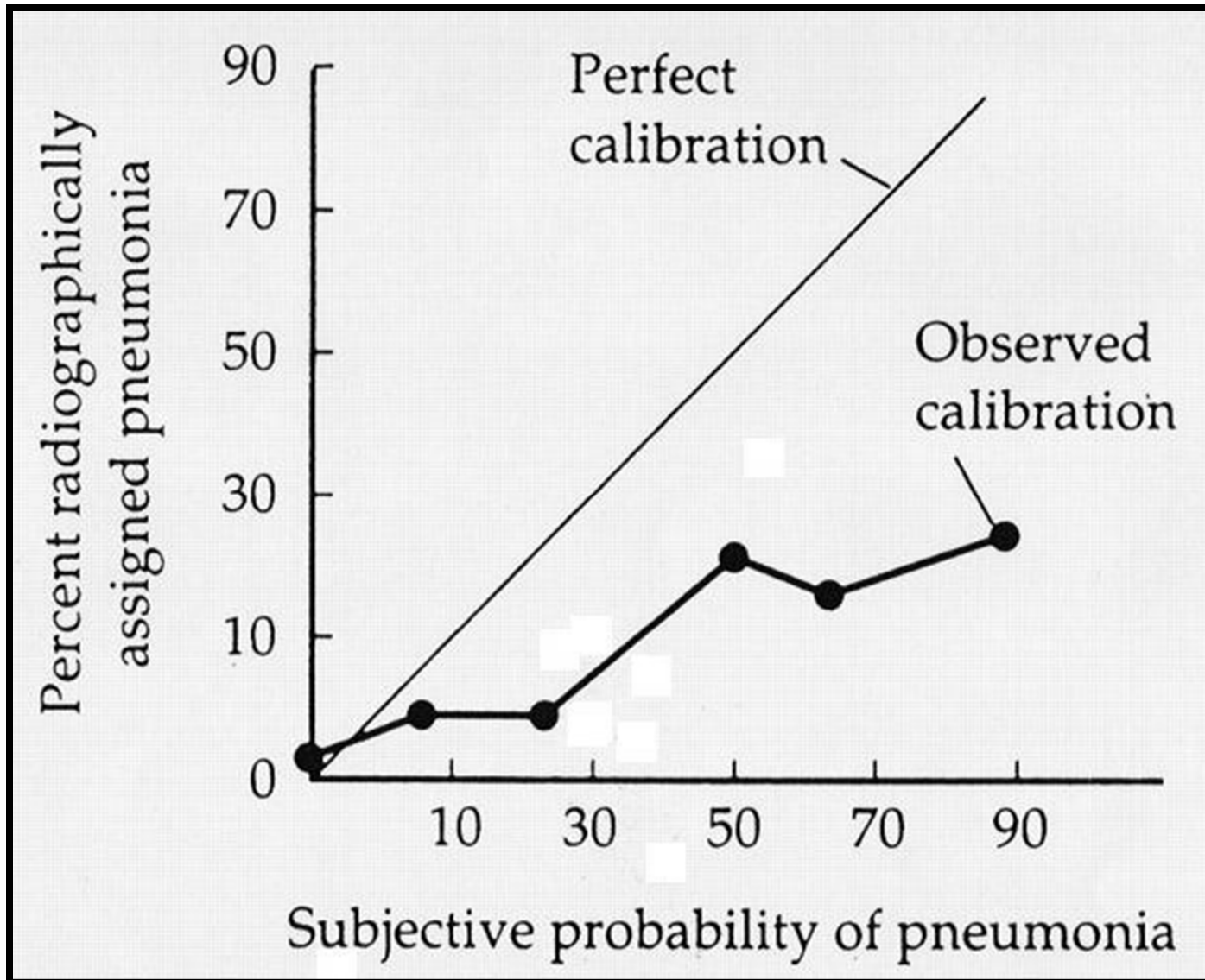
Decision Making

Hindsight Bias & Overconfidence

- **Arkes et al. (1981) - Doctors in a "foresight" group given medical histories and asked to assign probability estimates to 1 of 4 possible diagnoses.**

- **Doctors in "hindsight" group given same histories and same task, but also told the "correct" diagnosis.**

- **Probability estimates are 2-3 times higher in hindsight group, *even when revealed diagnosis is incorrect!***

- **Hindsight Bias - The post-hoc belief that you knew something before it occurred.**

- **The "*I was just thinking (about to say) that*" effect.**
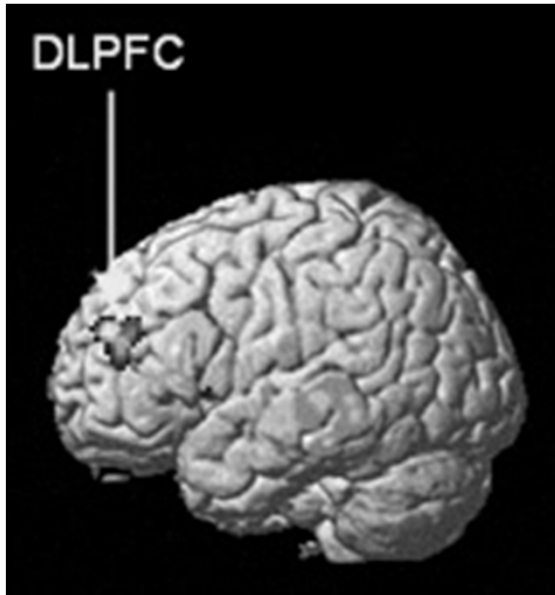
- **Overconfidence...**

Decision Making

Overconfidence in Physicians Estimates of Pneumonia

Neural Basis of Decisions

The role of emotion (and VMPFC) in DM.

Pile A

Pile B

Control subject — *Emo-rsp <u>before</u> drawing a card from risky deck (Pile A).*

Pile B · Pile A

Frontal patient — *No emo-rsp <u>before</u> drawing, but normal emo-rsp to wins & losses.*

Pile B · Pile A

<u>*Somatic Marker*</u>*: A visceral ('gut') feeling before a risky decision*

Neural Basis of Decisions

➢ **Dorsolateral Prefrontal Cortex (DLPFC).**

• **Most active during difficult, "executive" demands such as planning, multi-tasking, & inhibition.**

➢ **Ventromedial Prefrontal Cortex (VMPFC).**

• **Integrates emotion into judgment & decision-making.**

Is Thinking Irrational?

Why do we rely so much on heuristics?

- **Real-world Judgments & Decisions are made under time pressure, with ill-defined goals & info overload.**

- **When these factors are taken into account, heuristics make sense and may often outweigh the benefits associated with normative or algorithmic JDM.**

- **Satisficing (H. Simon) - Sacrificing the goal of optimal decisions in favor of those that are satisfactory.**

- **Heuristics often work!**

  - Events that come to mind quickly are usually of high frequency.

  - Instances of a category do often resemble the prototype.

  - Emotional reactions are usually a good index of risk.