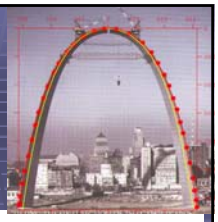
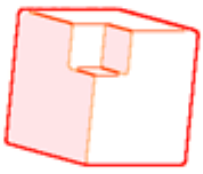
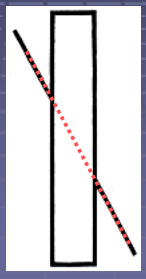
Cognitive Illusions

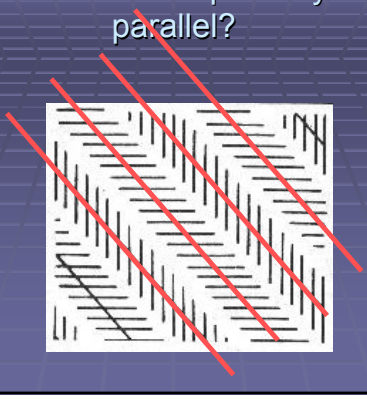




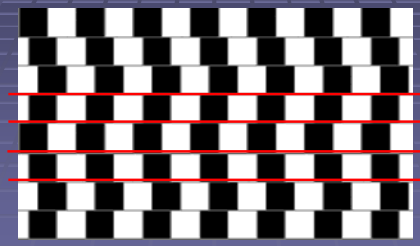
Is this line straight?



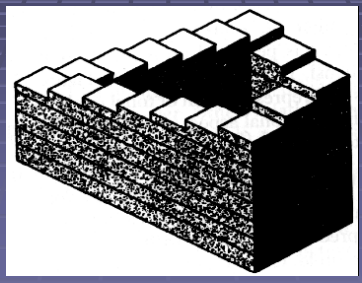
Can these lines possibly be parallel?



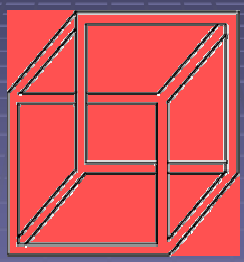
How about these?



Seeing what isn't possible



Seeing what isn't possible - 2



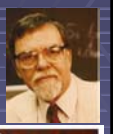
Ambiguities in real vision

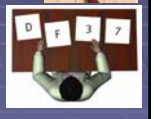
Normative Rationality

- Normative logic: rules for inference
  - Desiderata: truth preservation, completeness
- Normative decision making based on probability calculus and theory of games (von Neumann, Morgenstern, etc.)
- Adjusting probabilities on the basis of evidence:
  - Rev. Thomas Bayes (1702-1761)
  - **P** (*H*/*E*) = [**P**(*H*) **x P** (*E*/*H*)] / **P**(E)

Human Shortcomings

- Lusted and Ledley, 1950s, computer-based diagnosis
  - Results differed dramatically from best clinicians
  - Follow clinicians or the computer?
- Paul Meehl: statistically based prediction more reliable than the intuitive judgments of the experts in a host of domains
- Peter Wason: psychology of reasoning
- Amos Tversky and Daniel Kahneman
  - Heuristics and biases





Geographical Illusions

- If you flew north out of Atlanta, what northern US city would you come closest to?

Geographical Illusions

- If you left Atlanta flying east, where would you arrive in Europe?
- If you left NYC flying east, where would you arrive in Europe?
- If you left Berlin flying west, where would you land in the US?

Dutch Book

- Betting on the winner of the academy award
- Whoever wins, the house makes a profit
- Pays $200 and keeps $10

Actress	Odds Offered	Bets	Implied Probability
A	Even	100	0.5
B	3 to 1 against	50	0.25
C	4 to 1 against	40	0.2
D	9 to 1 against	20	0.1
Total		210	1.05

The Three-Card Problem

Three cards are in a hat. One is red on both sides (the red-red card). One is white on both sides (the white-white card). One is red on one side and white on the other (the red-white card). A single card is drawn randomly and tossed into the air.

a. What is the probability that the red-red card was drawn? (RR) 1/3

b. What is the probability that the drawn cards lands with a white side up? (W-up) 1/2

c. What is the probability that the red-red card was not drawn, assuming that the drawn card lands with the a red side up? (not-RR|R-up) 1/2 ??

Fair Bets

- A bet is fair to an individual if, according to the individual's probability assessment, the bet will break even in the long run.
- The following three bet are fair assuming the odds you have given:

Bet (a): Win $4.20 if RR;
lose $2.10
otherwise. [since you believe P(RR)=1/3]

Bet (b): Win $2.00 if W-up;
lose $2.00
otherwise. [since you believe P(W-up)=1/2]

Bet (c): Win $4.00 if R-up and not-RR;
lose $4.00 if R-up and RR;
neither win nor lose if not-R-up.
[since you believe P(not-RR|R-up)=1/2]

Results

There are three possible outcomes

1. Some card other than red-red is drawn, and it lands with white side up. That is, W-up and not-RR
2. Some card other than red-red is drawn, and it lands with a red side up. That is, R-up and not-RR.
3. The red-red card is drawn, and it lands (of course) with a red side up. That is, R-up and RR.

	1	2	3
a.	–$2.10	–$2.10	+$4.20
b.	+$2.00	–$2.00	–$2.00
c.	±$0.00	+$4.00	–$4.00
total	–$0.10	–$0.10	–$1.80

Dutch Book

- The bets that you accepted have an interesting property:

  No matter what card is drawn in the three-card problem, and no matter how it lands, you are guaranteed to lose money.
- This is called a Dutch Book
- Dutch Book Theorem:
  - Suppose that an individual A is willing to accept any bet that is fair for A. Then a Dutch book can be made against A if and only if A's assessment of probability violates Bayes' Rule.

Sunk Cost

- Someone you long wanted a date with agrees to dinner and a play and you each lay out the $75 for the play. During dinner you discuss the negative reviews the play has gotten and agree that you would both prefer a walk by the beach followed by coffee and dessert. But since you are each out $75 already, you decide to go to the play.
- "A cost incurred in the past that will not be affected by any present or future decision. Sunk costs should be ignored in determining whether a new investment is worthwhile."

Heuristics and Biases

- Not easily overridden, if at all—obligatory
- Provide a simpler procedure for reaching a decision than the normatively optimal one
- The patterns of error will be systematic—there will be specific types of problems on which the heuristics will result in errors
- The pattern of errors is a diagnostic for what procedure was being used

Modules (Again)

- Different views of what modules are
- Fodor: domain-specific, mandatory in their operation, allow only limited central access to the computations of the modules, fast, ***informationally encapsulated***, have shallow outputs, associated with fixed neural architectures, exhibit characteristic and specific breakdown patterns, exhibit a characteristic pace and sequencing in their development
- Evolutionary Psychology: Responsible for overall behaviors
- Less extreme views:
  - Deal with subtasks
  - Not so encapsulated, etc.