Evolution and Decision Making

What does evolution tell us about how we make decisions

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Bird brains and difficult decisions

When a mother bird needs to feed chicks in her nest, she must decide how much time to leave the nest unprotected while gathering food. She may consider

- How much food she can gather per second
- How much food her chicks need
- How vulnerable the nest is
- How exhausted she is

Bird brains (continued)

Evolution has equipped birds with the brain power to balance these things very well.

Birds can be fooled

Biologists can manipulate the cues that the birds pick up on (making the nest seem more vulnerable than it is, etc).
Observing where birds get it wrong is the best way to understand what their cues and and rules are.

Sometimes things go wrong

- Birds fly into windows
- Moths fly into flames
- Ground wasps can be tricked into doing the silliest things
- Humans, well . . .

. . . That's what the rest of this presentation is about.

Opportunity knocks

Any work that birds (or humans) put into decision making is work that doesn't go into other things. Note that work put into decision making includes developing and maintaining a decision making tool in the first place.

So decision makers are only *Boundedly Rational*.

Some days you eat the bear

Two friends are camping and their campsite is attacked by a bear. One person begins to put on his running shoes.
"What do you think you are doing? You can't out run the bear."
"I don't need to out run the bear. I only need to out run you."
Evolution, thus gave us decision making mechanisms that are *good enough*, but only *Boundedly Rational*.

All's well that ends well

The single, number 1 fact to keep in mind while discussing how we make decisions:

If the decision making mechanisms that nature gave us didn't work very well, we wouldn't be around to talk about it.

Patterns of superstitions

Humans (and others) are very quick to identify patterns from small samples. We use what is sometimes called the *Representativeness Heuristic* or the *Small Sample Bias*. This leads to

1. The gambler's fallacy
2. The hot-hand fallacy
3. The base-rate fallacy (possibly)

When is non-optimality optimal?

The general view is that a false negative (not noticing a pattern) is more costly than a false positive ("noticing" a pattern that isn't real.) If it's too expensive to build a perfect mechanism, then build one that errs on the side of over sensitivity.

Some costs

1. General superstition
2. MMR inoculations in the UK
3. Gambling
4. Quackery

Base rate fallacy

When you have imperfect information about an individual member of a class, that information can be integrated into information about the class as a whole to get an estimate about the member. This is done using *Bayes Theorem*:

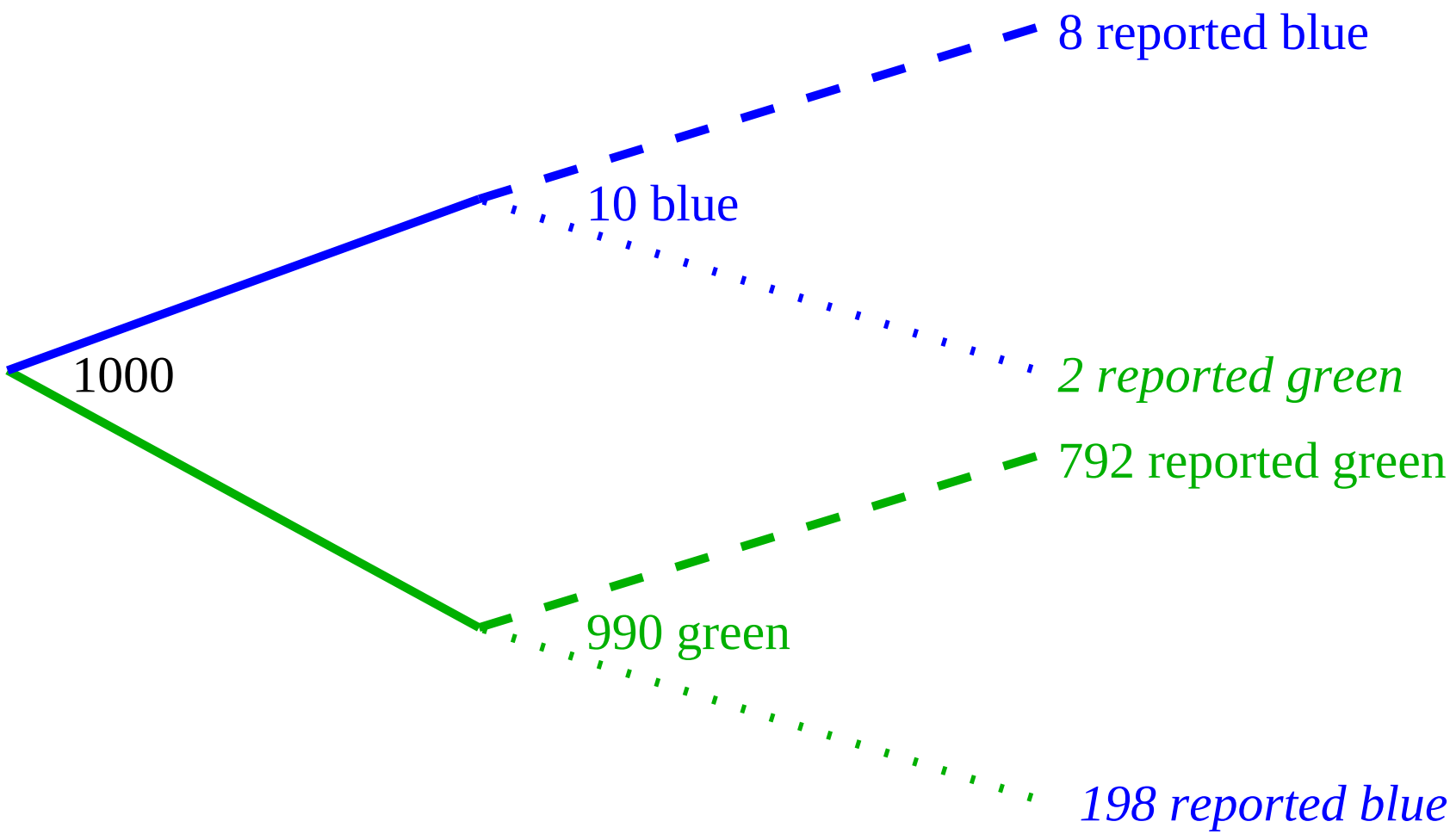
$$p(H/D) = \frac{p(D/H) \cdot p(H)}{p(D)}$$

Loosing your marbles

Alice is color blind, but given a blue or a green marble she can correctly identify the color of the marble 80% of the time and is wrong 20% of the time.

You have a bag with 1000 marbles, ten of which are blue and 990 are green. Alice draws out a marble and identifies it as blue. What are the chances that it is blue?

Bayes tree


8 reported blue
10 blue
1000
2 reported green
792 reported green
990 green
198 reported blue

The 4% solution

From the diagram in the previous slide we see that there are $8 + 198 = 206$ ways in which Alice could have reported a marble as blue. But only 8 of those are correct reports, leading to there being an $8/206 \approx 4\%$ chance that the marble really is blue.

Ignoring base-rate information

People often tend to not fully take into account the base-rate information. Examples can be constructed in which people typically ignore the base-rate information entirely. There is ongoing research discussing exactly what conditions cause people to under value the base-rate information. My own research suggests that when the base-rate information is about a "natural kind" of human, people don't ignore the base-rate information, but do rely on those stereotypes.

Base-rate fallacy tragedies I

Medical diagnoses: Until doctors were explicitly taught about the base-rate fallacy, they massively and systematically over-diagnosed breast cancer, by relying exclusively on the results of mammograms.

Base-rate fallacy tragedies II

Jury decisions: A UK court has convicted a man of rape based on a *DNA match only*. If that is the only reason to suspect him, then he is most likely innocent as the small chance of a false positive is greater than the base-rate chance of his guilt. The judge specifically did not allow the defense to explain Bayesian reasoning, while the judge explained it to the jury wrong. An appeal upheld the conviction

Base-rate fallacy tragedies II (cont)

whilst the prosecution could properly rely upon a DNA sample supported by statistical evidence as to the random occurrence ratio of the DNA match, in the absence of special circumstances the defence should not be permitted to adduce expert evidence based on Bayes Theorem to encourage the jury to attach mathematical probabilities to non scientific evidence

Reported: [1996] 2 Cr. App. R. 467; [1996] Crim. L.R. 898
Reference: Times, May 9, 1996

Yes, we have no mangos

Alice and Bob eat mangos and pears exclusively for their vitamin F content. But they metabolize them differently. Alice absorbs 100 μg of vitamin F from every mango she eats and no vitamin F from the pears. Bob, on the other hand gets 50 μg for every mango and 50 μg for every pear.

You have 12 mangos and 12 pears to distribute between Alice and Bob. How would you distribute those justly?

Solution 1

The economists in the room probably thought to auction them off, knowing that Alice would bid higher for mangos than Bob would, but she wouldn’t bid on the pears at all.

Solution 2

But normal people would have tried to solve for getting Alice and Bob the same amount of vitamin F (with Alice gets 8 mangos and no pears, Bob gets all the pears and 4 mangos). That leads to each getting 800 μg of vitamin F, for a total of 1600 μg absorbed.

Solution 3

- If Alice gets all the mangos (1200 μg) and Bob gets all the pears (600 μg), then we have a communal total of 1800 μg.
- The “just” solution leads to a total loss of 200 μg of vitamin F.

When is solution 2 attractive?

- If you picked solution 2, would your answer be different if you knew that Bob's diminished ability to make use of mangos was through heavy drinking?
- Because women take longer in public toilets than men (through no fault of their own) should there be more toilets for women than for men in places frequented by equal amounts of men and women?

I know what I like. . . don't I?

1. Which would you prefer: (a) $50 now, or (b) $100 six months from now?
2. Which would you prefer: (a) $50 12 months from now, or (b) $100 18 months from now?

Comments

We've seen

- A number of cases where humans systematically make seemingly irrational decisions.
- The mechanisms leading to those appear to be fairly well hard-wired and only explicit education reduces them.
- These sorts of mechanisms affect many real world decisions and are not merely laboratory artifacts.

Comments (cont.)

- Humans are not the only species effected.
- Some of these have plausible evolutionary explanations, others are the subject on on-going debate, others require more research.

Where to find this

These slides are available at

`http://www.goldmark.org/livia/misc/ev-dec.pdf`