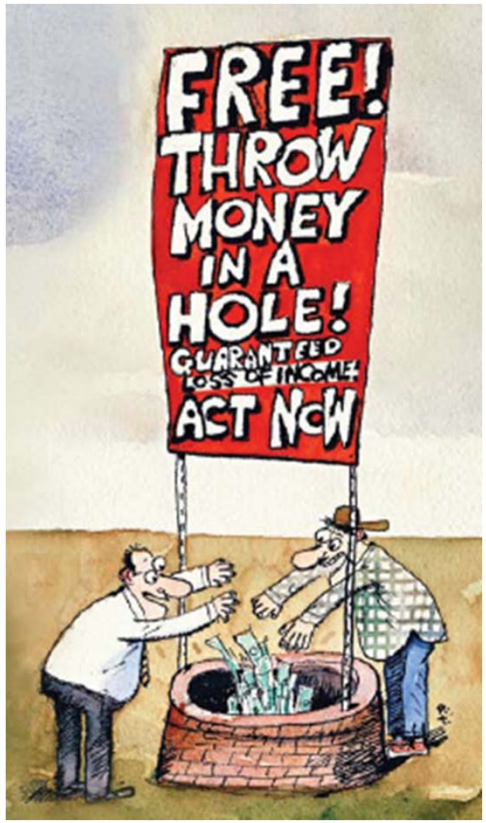


Rethinking Rationality
Behavioral Economics and its Implications for Insurers

Casualty Actuaries of New England
Sturbridge, MA

April 2, 2012

Jim Guszcza, FCAS, MAAA

Deloitte Consulting LLP
University of Wisconsin-Madison

Agenda

Introduction

Failures in Probabilistic Reasoning

Conceptual Development

Heuristics and Biases from A to B

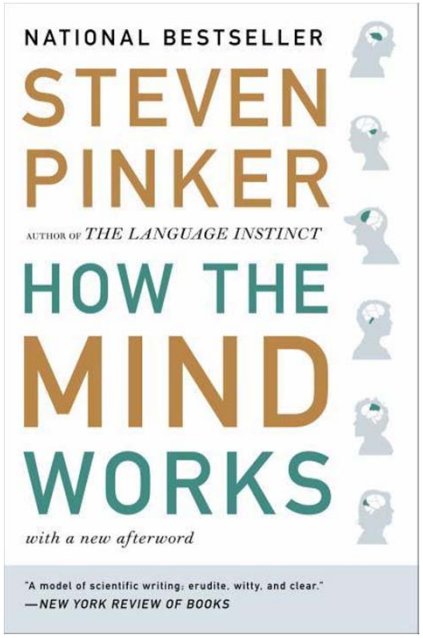
Implications for Actuaries and Insurers

Introduction

Behavioral Economics is Cutting Edge

"[Recent decades'] work on human cognition and probabilistic reasoning should be up there as **one of the first things any educated person should know**."

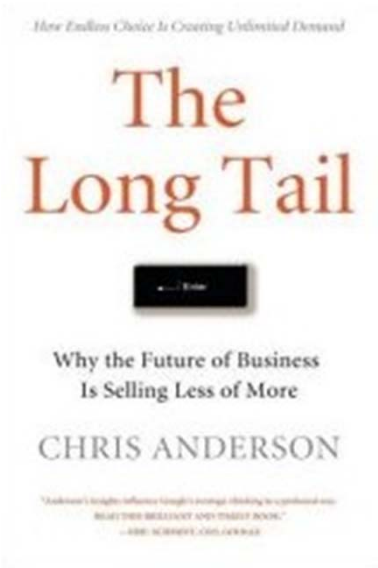
-- Stephen Pinker, Harvard University linguist (paraphrase)



Another Major Trend

"**Perhaps the most important cultural trend today**: The explosion of data about every aspect of our world and the rise of applied math gurus who know how to use it."

-- Chris Anderson, editor-in-chief of *Wired*



What is all the Fuss About?

"The radical insight of behavioral economics is that people are human."

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  - **Theme 1:** Decision-makers at insurance companies are human

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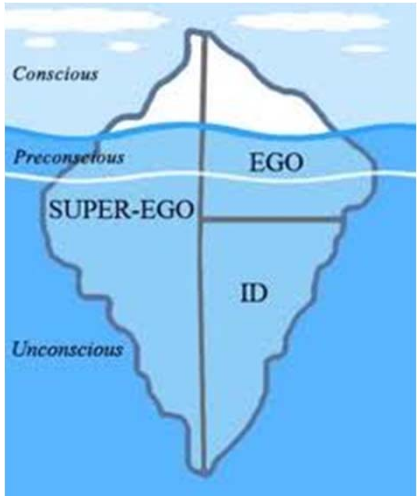
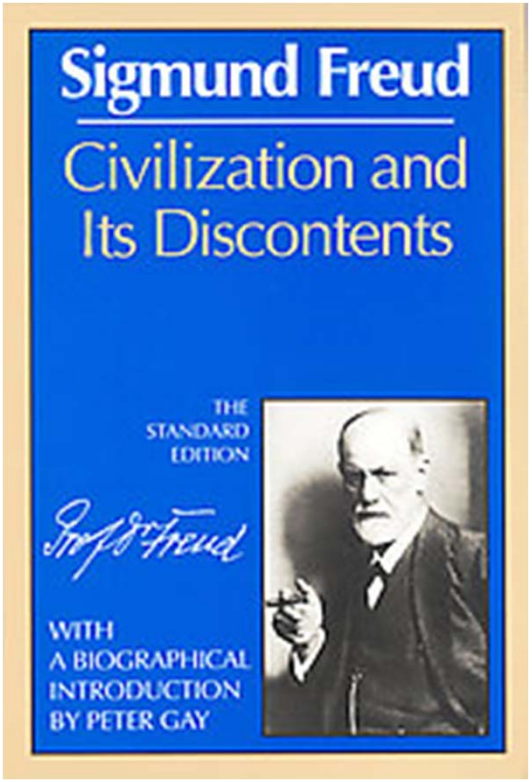
- So behavioral economics is important in insurance for two classes of reasons:
  - **Theme 1:** Decision-makers at insurance companies are human
  - **Theme 2:** People making insurance purchasing decisions are human

Rational Expectations and its Discontents

Traditional Views of Human Irrationality



- Human irrationality is a vestige of our primordial state
- Laws and social norms keep irrationality in check



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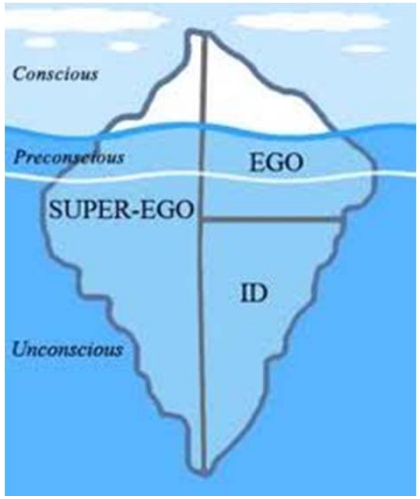
- …deviations from societal norms
- Manifested in times of mass hysteria, political demagoguery, economic crisis.

Traditional Views of Human Irrationality



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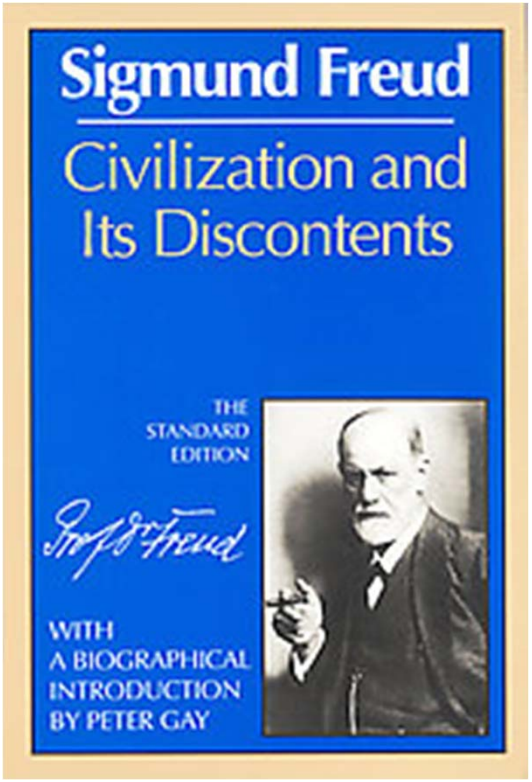

- Manifestations are anomalous…
- …deviations from societal norms
- Manifested in times of mass hysteria, political demagoguery, economic crisis.
- (or football games)

Meet Homo Economicus

- A major philosophical building block of mainstream 20th century economics:

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- **The assumption that economic actors are rational.**

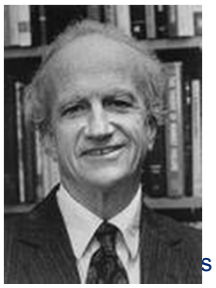
Meet Homo Economicus

- A major philosophical building block of mainstream 20th century economics:

- **The assumption that economic actors are rational.**

- Here is a classic statement of the position:

> The combined assumptions of maximizing behavior, market equilibrium, and stable preferences, used relentlessly and unflinchingly, form the heart of the economic approach as I see it.... All human behavior can be viewed as involving participants who **maximize their utility** from a **stable set of preferences** and **accumulate an optimal amount of information** and other inputs in a variety of markets
>
> -- Gary Becker, *The Economic Approach to Human Behavior*
>
> (bolding added)



But…

Does Becker's "unflinching assumption" really approximate reality?

Maximizing and Satisficing

- Cracks in this foundation were already being discussed by Herbert Simon in the 1960s.
- When making inferences, predictions, and decisions people do not have unlimited information, time, and computing power.
- Simon: we are only **boundedly rational**.

- We don't maximize… we "**satisfice**".
- We find a solution that gives up less utility than is gained by excessive deliberation.

Heuristics and Biases

- Starting in the late 1970s Daniel Kahneman and Amos Tversky shook the foundations of classical economics.
- Kahneman and Tversky: when we deliberate we use mental **heuristics** (rules of thumb)
- It turns out that many of these heuristics are systematically **biased**
- **Behavioral economics studies the economic implications of biased cognition**
  - These lessons have been taken on board by economists, financial economists, and marketing researchers
  - Actuaries should also pay attention

How We Decide

- In *Predictably Irrational*, Dan Ariely describes an ad for *The Economist* magazine that offered the following three options:

1. Internet-only access:	$59
2. Print edition	$125
3. Internet plus print edition	$125

- This seems strange:
- Option 3 clearly dominates Option 2
  - It offers an additional benefit (internet access) for no marginal cost
- So why would *The Economist* offer Option 2 at all?

How We Decide

- Ariely tested the behavior of some of his MIT students.
  1. Internet-only access ($59) — 16 students
  2. Print edition ($125) — 0 students
  3. Internet plus print edition ($125) — 84 students

Of course nobody chose Option 2…

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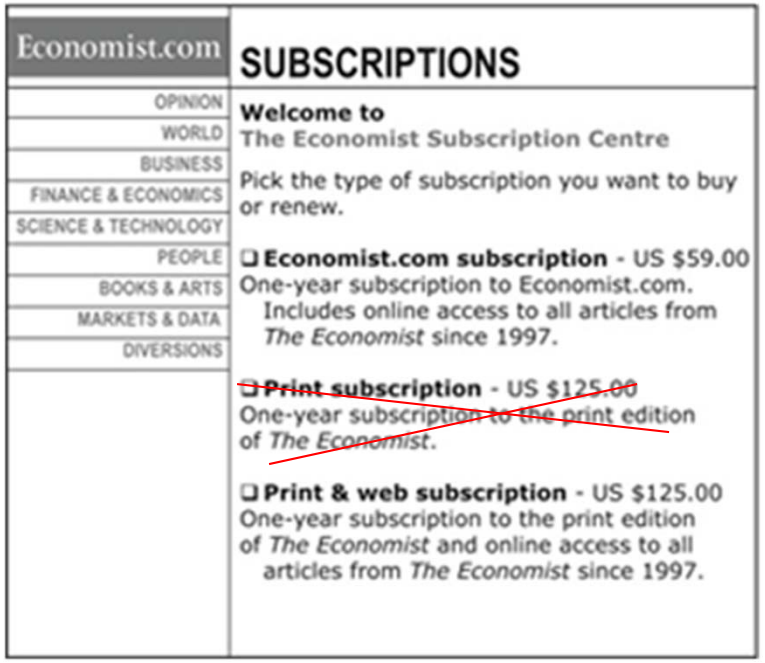
…So eliminating Option 2 should make no difference, right?



Stable Preferences?

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Of course nobody chose Option 2…

…So eliminating Option 2 should make no difference, right?

- Wrong: here is the result when he made the offer *sans* option 2:
  1. Internet-only access ($59) — 68 students
  2. ~~Print edition ($125)~~
  3. Internet plus print edition ($125) — 32 students

How We Decide

- Option 2 was little more than a decoy
- Nobody was expected to buy it
  - (we're not *that* irrational)
- But it served as a basis for comparison against which Option 3 looked good
- No such basis for comparison was provided for Option 1
- Does maximizing utility over a stable set of preferences really describe how we decide?

Flaws in Probabilistic Reasoning

Parable #1: There's Something About Linda

- Think about this person:

- Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations

There's Something About Linda

- Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations

Now rank these possible scenarios in order of probability:

- Linda is active in the feminist movement
- Linda is a bank teller
- Linda is a bank teller and is active in the feminist movement

There's Something About Linda

- Daniel Kahneman and Amos Tversky posed precisely this question to several groups of people

- They found that **87%** of the people thought that "feminist bank teller" was more probable than "bank teller"

There's Something About Linda

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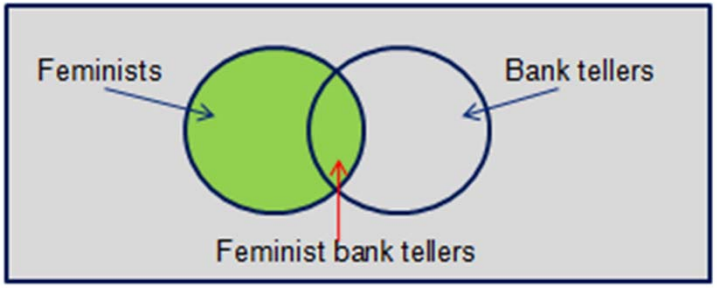
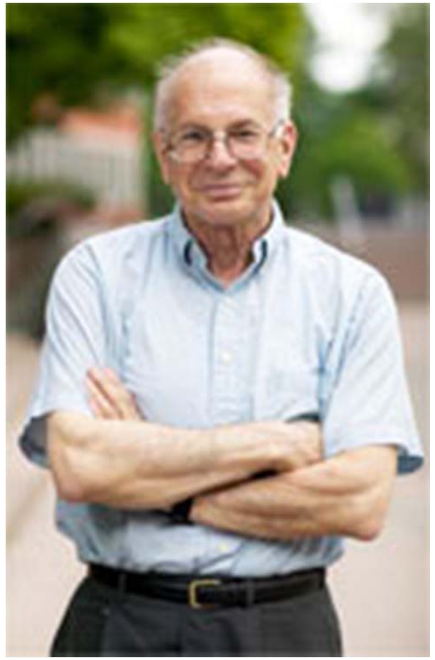
- They found that 87% of the people thought that "feminist bank teller" was more probable than "bank teller"

- But this is logically impossible.
  - Mathematical fact: Prob(A&B) < Prob(B)
  - So in particular: Prob(feminist & bank teller) < Prob(bank teller)



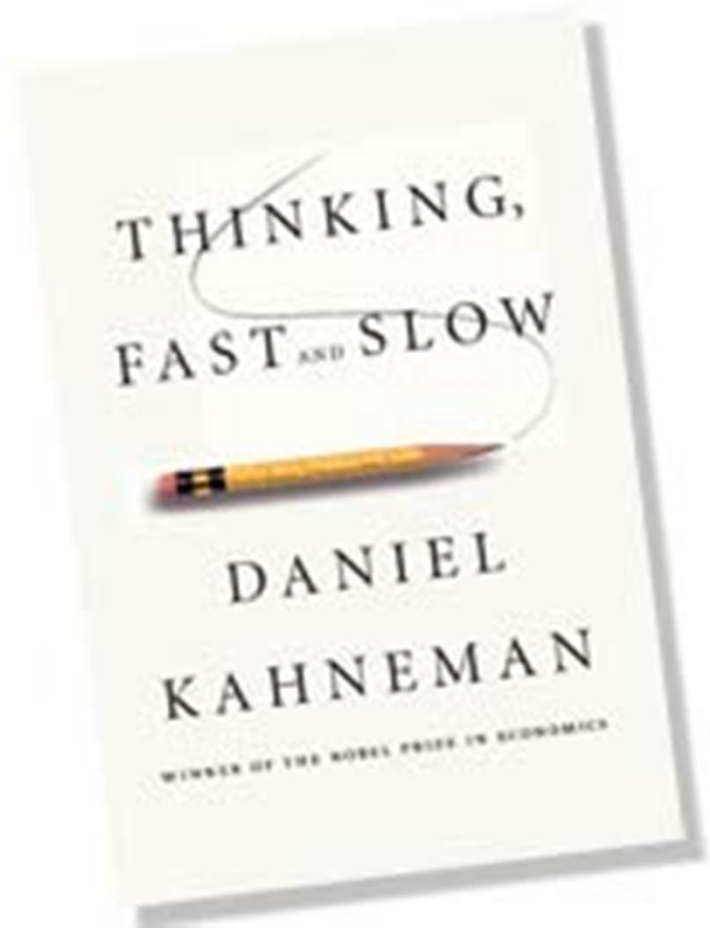
The Moral of This Story

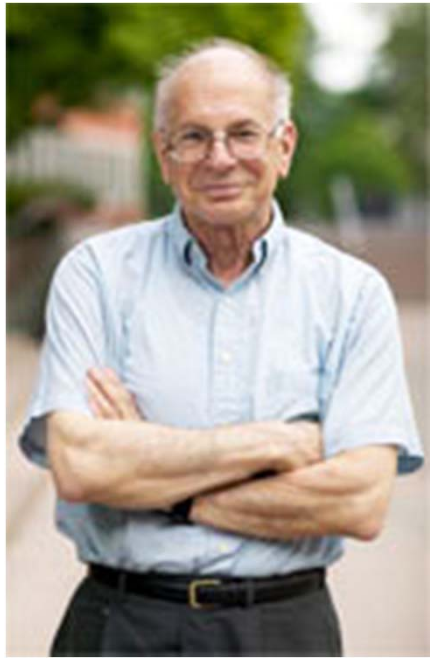
- Kahneman: there are two types of mental operations.
- Type 1: automatic, effortless, **associatively** coherent.
- Type 2: controlled, effortful, **logically** coherent.



- Most of our mental operations are “Type I” in nature.
- And “Type I” has a lot of trouble with statistics.

(The Book of the Year)





Parable #2: Kind of Blue

- Let's do another one:

- **A cab was involved in a hit-and-run accident at night.**

Kind of Blue

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  - **85% of the taxis in town are green; 15% are blue.**

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Kind of Blue

- Let's do another one:

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  - 85% of the taxis in town are green; 15% are blue.
  - A witness identified the cab as blue.
  - **Under these conditions, witnesses correctly identify the taxi color 80% of the time.**

Kind of Blue

- Let's do another one:

- A cab was involved in a hit-and-run accident at night.
  - 85% of the taxis in town are green; 15% are blue.
  - A witness identified the cab as blue.
  - Under these conditions, witnesses correctly identify the taxi color 80% of the time.

- **Given the witness' testimony, what is the probability that the cab involved in the accident was in fact blue?**

A Baseless Estimate

- **People typically answer 80%**

- … they say there is an **80% probability** that the hit-and-run-cab is **blue**.

- (after all, witnesses like this are correct 80% of the time…)

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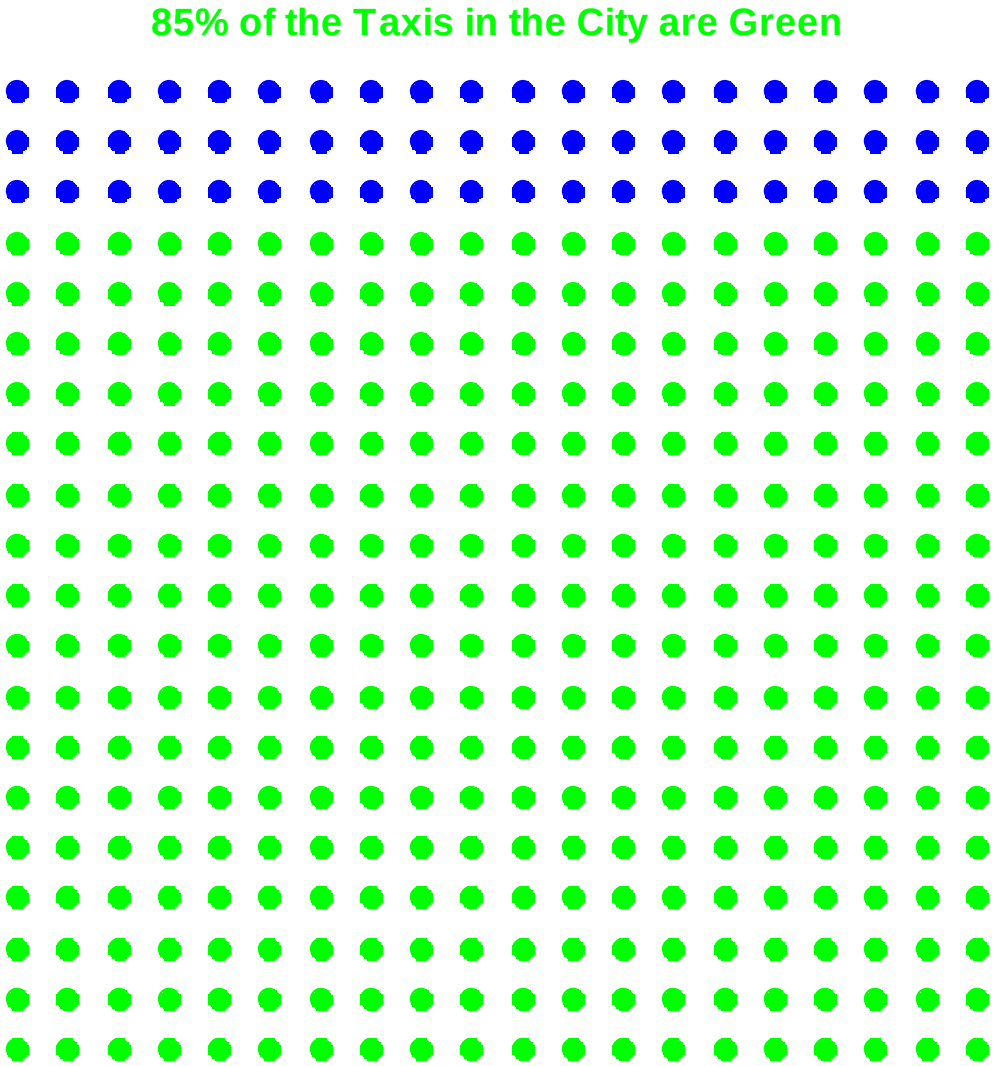
- How close is this to the truth?

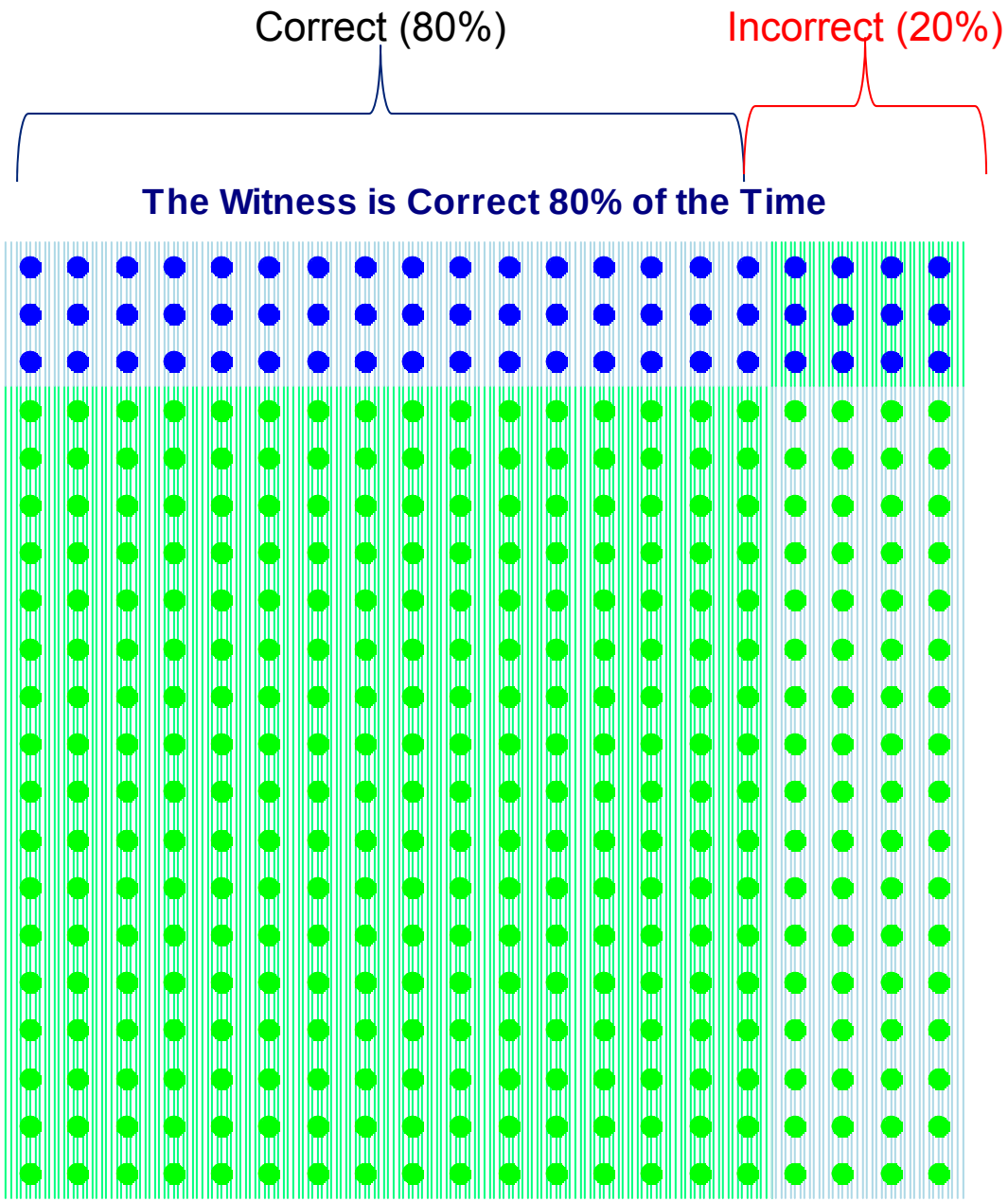
Prior Knowledge

- This we know:
- **85%** of the city's taxis are **green**.



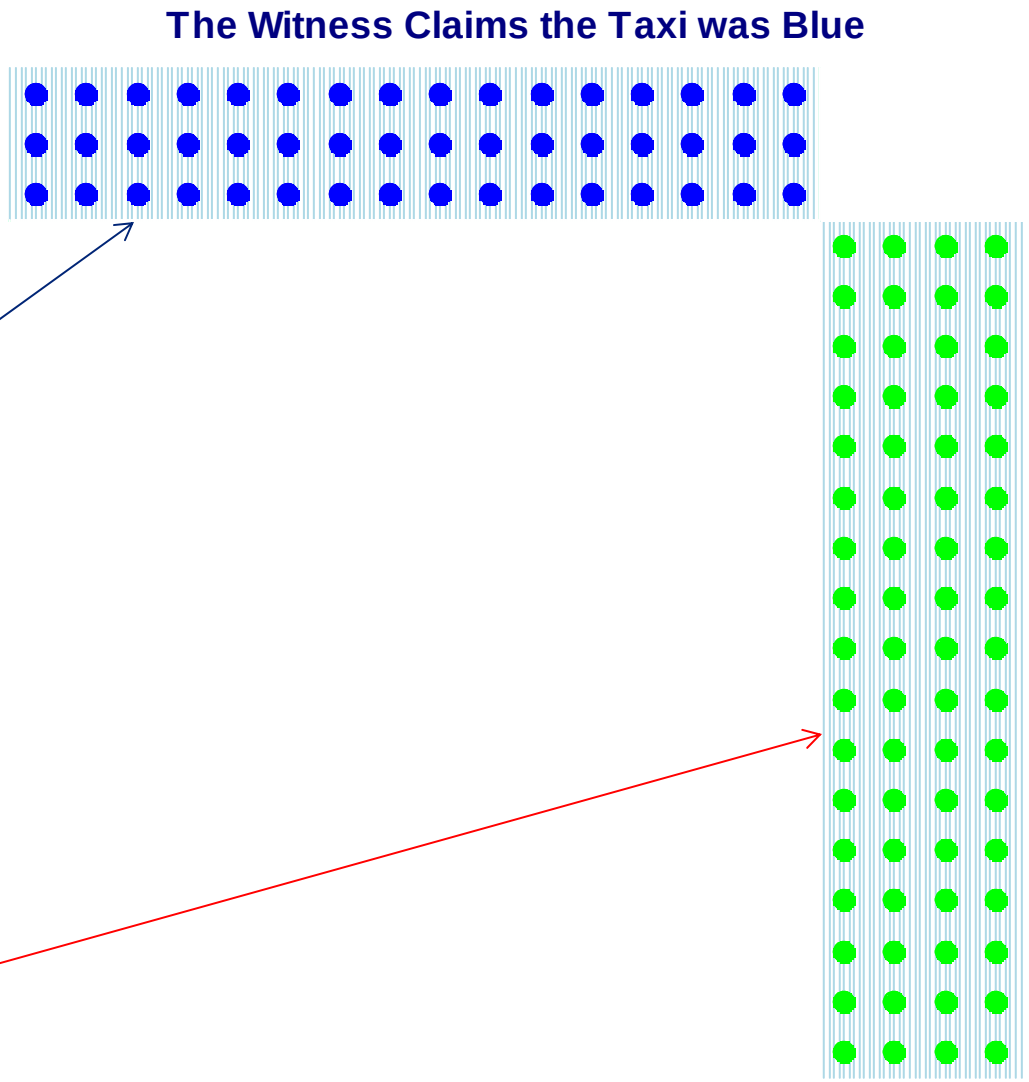
Probabilistic Evidence

- This we know:
- **85%** of the city's taxis are **green**.
- Similar witnesses in similar circumstances correctly identify the color **80%** of the time.



Updating on the Evidence

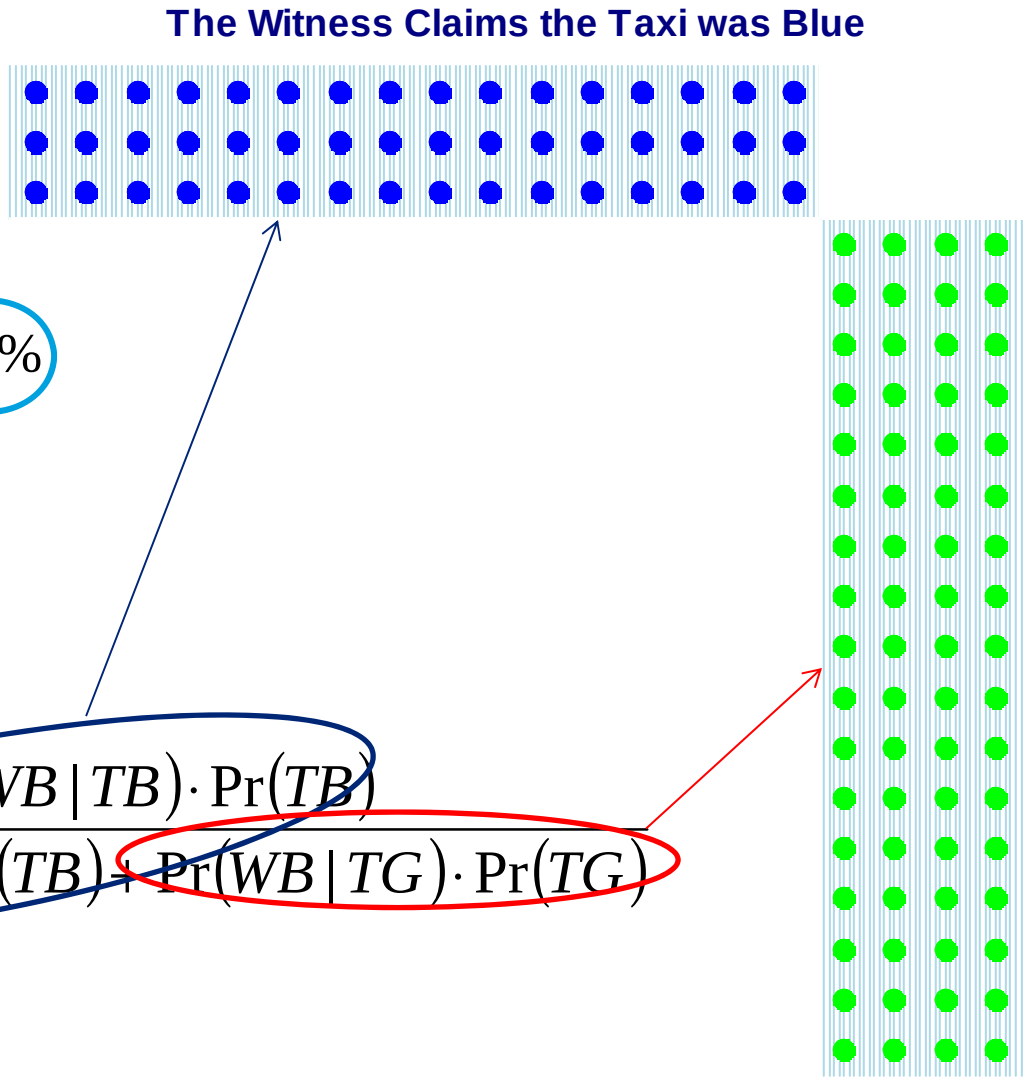
- Given that the testified “blue”, we are either in…
- …the state of the word where the taxi really was **blue** and the witness was **correct**…
- … or the state of the world where the cab really was **green** and the witness was **incorrect**.



Bayes Rules

- Viewed in this way, the answer is easily grasped:

$$\frac{(0.80)\cdot(0.15)}{(0.80)\cdot(0.15)+(0.20)\cdot(0.85)} \approx 41\%$$



- We are really doing Bayes:

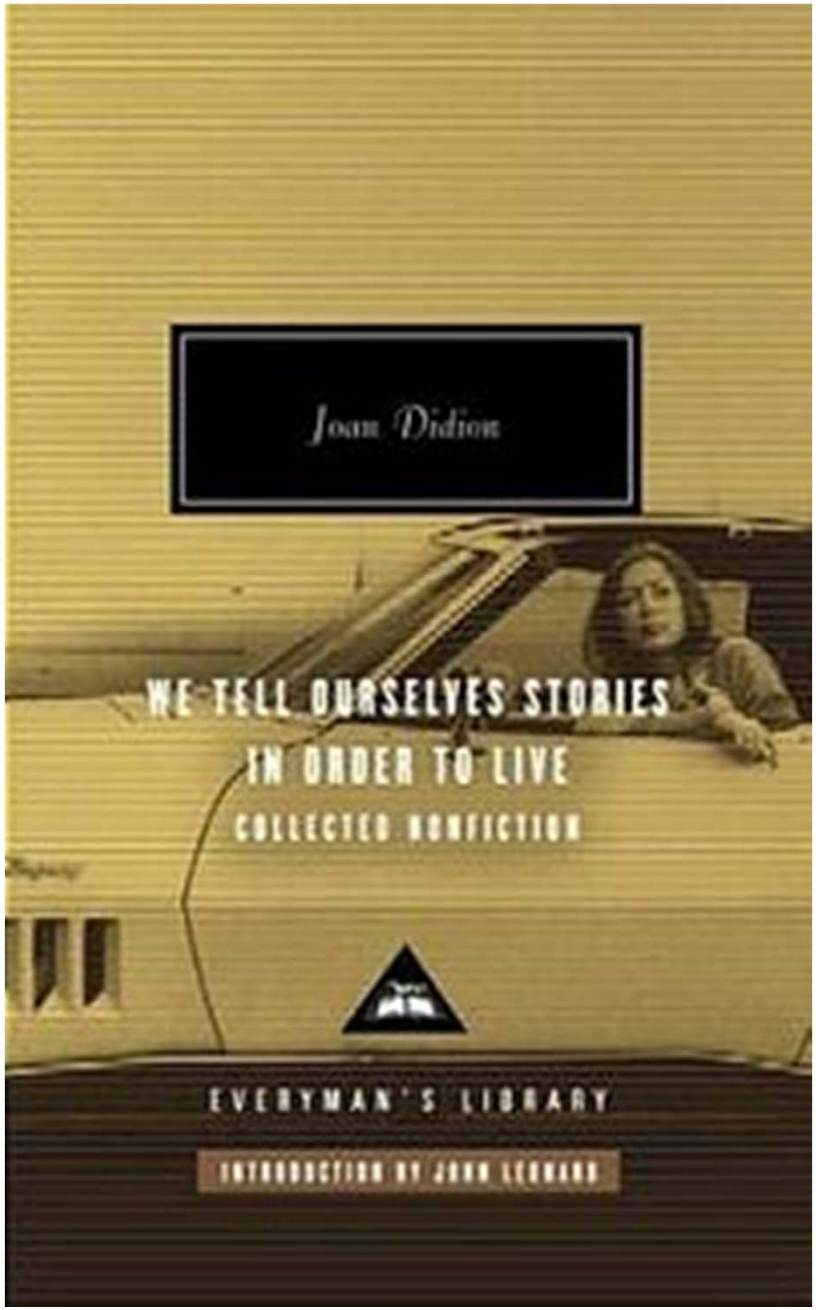
$$\Pr(TB \mid WB) = \frac{\Pr(WB \mid TB)\cdot\Pr(TB)}{\Pr(WB \mid TB)\cdot\Pr(TB)+\Pr(WB \mid TG)\cdot\Pr(TG)}$$

Now if We Tweak the Question…

- Now suppose we state that there are an equal number of green and blue taxis but that:

- **"85% of taxi accidents involve green taxis."**
- When the question is posed in this way, people **do** reflect the base rate in their reasoning!
- The statistical information about base rates is ignored….
- … but people instantly form a "stereotype" … or construct a "causal narrative"… that blue cab drivers are more risky.
  - This gets factored into the calculations.
  - Why: it's a story about individuals, not statistical ensembles.

We Tell Ourselves Stories in Order to Live



Rational Expectations or Mental Shotgun?

Anchoring and Adjustment

- When estimating an unknown quantity we tend to begin with a known quantity (an “anchor”) and adjust from there.

- **Innocuous example:** Guessing the population of Minneapolis.
  - Someone who lives in Madison and adjusts this known quantity upward
  - Someone who lives in Chicago and adjusts this known quantity downward

Anchoring and Adjustment

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- **Insidious examples:** First write down the last digits of your social security number.

Anchoring and Adjustment

- When estimating an unknown quantity we tend to begin with a known quantity (an “anchor”) and adjust from there.

- **Insidious examples:** First write down the last digits of your social security number. Then estimate:
  - What year did Attila the Hun invade Europe?
  - How many doctors practice in Manhattan?
  - How much would you pay for this bottle of wine or that book?

- **The numbers will be correlated.**

Justice is Blind (to Anchoring)

- Experienced judges in an experiment in Germany:
  - Read a description of a woman who had been caught shoplifting.
  - Then rolled a pair of dice that were loaded so each roll landed either 3 or 9.
  - The judges were then asked whether the number of months of their sentence would be greater or less than the number of spots that came up.
  - The judges were then instructed to specify the exact prison sentence they would give to the shoplifter.

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- On average, those who had rolled a 9 said they would sentence the shoplifter to 8 months; those who rolled a 3 said they would sentence her to 5 months
- A **50%** anchoring effect

$$\frac{8-5}{9-3}=50\%$$

Anchoring and Insurance Purchasing

- Observation: people tend to buy too much insurance
  - Full-coverage auto liability policies
  - Zero-deductible medical plans
  - Collision damage waiver for rental cars: ≈$15/day ≈ $5400/year
  - Cell phone loss coverage

- Possible explanation:
  - Shaperia and Venezia: perhaps because the price of full coverage policy serves as an anchor and makes deductible policy seem overpriced.

- Another failure of probabilistic reasoning…

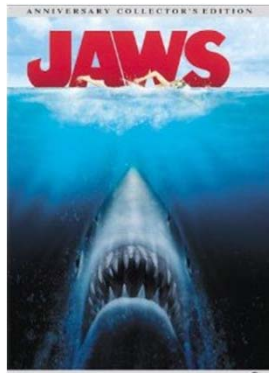
- Purchasers likely take into account the price of the deductible… but not the probability of an accident.

The Availability Heuristic

- People assess the probability of risks by asking how readily examples come to mind.

- How “salient” and “cognitively available” they are.

- Examples:
  - E.g. people estimate a higher frequency of words ending in ‘ing’ than words whose 2nd to last letter is ‘n’.
  - Car crashes after 9/11 spiked up because people stopped flying
  - Which claims more lives in the United States: homicides or suicides?
  - Which is a more likely cause of death in the United States:
    being killed by falling airplane parts or being killed by a shark?
  - And today… terrorism fears… the TSA… ?



The Availability Heuristic and Insurance

- This would seem to have obvious implications for actuarial and underwriting work.
  - Selecting trend factors
  - Selecting loss development factors
  - Selecting pricing mods
- And also insurance purchasing behavior.
- Examples:
  - The demand for earthquake and flood insurance sharply increases after an earthquake or flood… then diminishes as the memory of the event recedes.
  - Wharton study: participants were willing to pay a higher premium for $100,000 of terrorism insurance than the same amount of insurance for death due to any reason.

An Unbiased Sample of Further Biases

- **Loss aversion**: the pleasure of gaining an item is less than the pain of giving it up.
  - People are risk-averse when presented between a choice between a sure thing worth *x* and a gamble with expected value > *x*.
  - But then they become risk-seeking when the choice involved *losses*…
  - (willing to gamble to avoid painful losses)
  - See also – the endowment effect

- **Confirmation bias**: people favor information that confirms preconceptions regardless of truth.
  - Recall Kahneman's associative coherence…

- **Hindsight bias**: Past events are said to be more predictable after the fact than before they took place.

An Unbiased Sample of Further Biases

- **Mental accounting**: people create separate mental accounts when making decisions.
  - "This is my rent money and this is my mad money"

- **Social effects, contagion, availability cascades, conformity effects.**
  - Herd behavior
  - Attitudes, behaviors, beliefs, memes propagating through social networks

- **Decision fatigue**: radically different decisions result based on how many other decisions have been made between meals.
  - (!)

Decision Fatigue and Parole Decisions

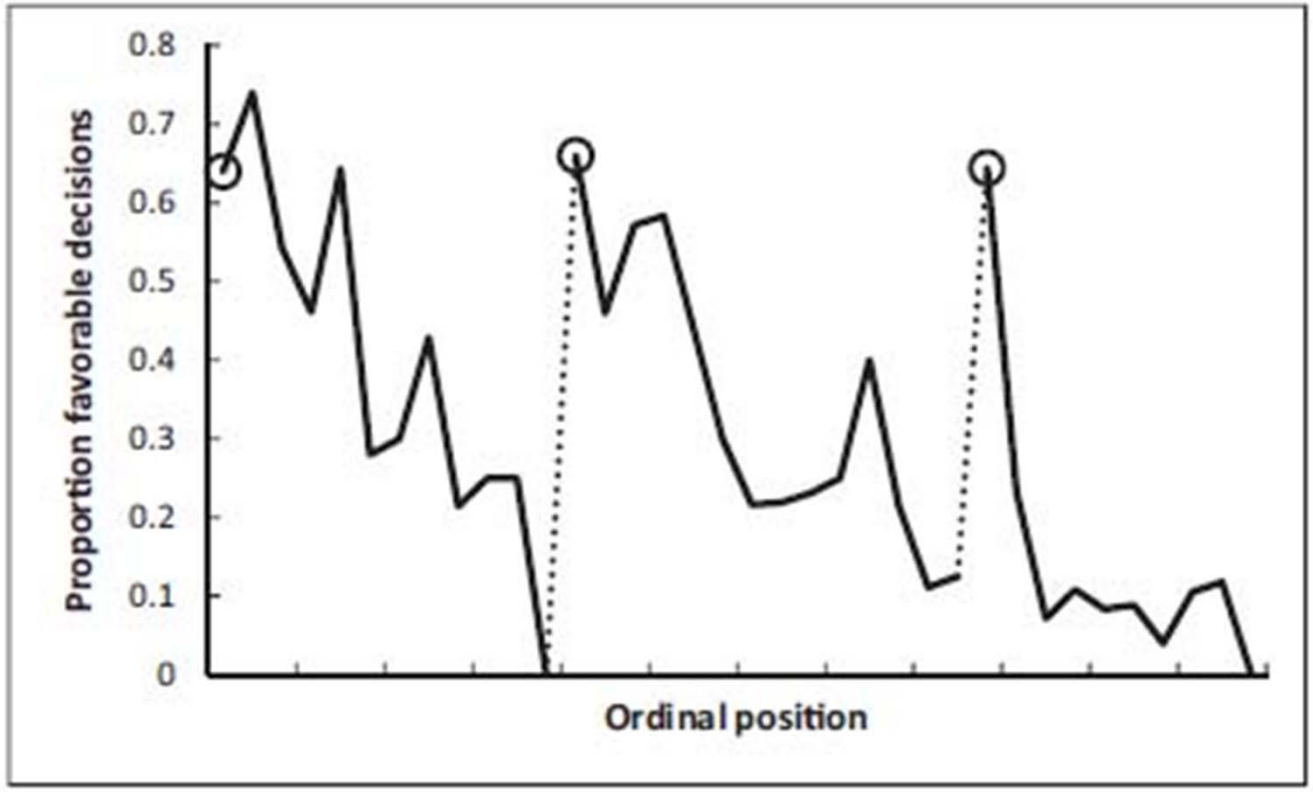


Fig. 1. Proportion of rulings in favor of the prisoners by ordinal position. Circled points indicate the first decision in each of the three decision sessions; tick marks on *x* axis denote every third case; dotted line denotes food break. Because unequal session lengths resulted in a low number of cases for some of the later ordinal positions, the graph is based on the first 95% of the data from each session.

http://economix.blogs.nytimes.com/2011/04/14/time-and-judgment/

Heuristics, Biases, and the Ubiquity of Business Analytics

A Prescient Remark

"The central concern of administrative theory is with the boundary between rational and nonrational aspects of human social behavior."

-- Herbert Simon, *Administrative Behavior* (1947)

Overconfidence and Optimism Bias

- A person's confidence in a judgment or decision is not based on:
  - An unbiased evaluation of the evidence and its quality
  - A statistically meaningful estimate of the probability of being correct

- In general, confidence is a feeling that is determined by:
  - The narrative coherence of a story we tell ourselves
  - The ease with which the story comes to mind ("cognitive availability")

- **Overconfidence:** individuals overestimate the precision of their knowledge and information.
  - Particularly experts who make certain types of decisions for a living!

- **Optimism Bias:** a systematic tendency for individuals to be overly optimistic about the outcome of planned actions. A particular manifestation of managerial overconfidence.

The Narrative Fallacy

- “The confidence we experience as we make a judgment is not a reasoned evaluation of the probability that it is right. Confidence is a feeling, one determined mostly by the coherence of the story and by the ease with which it comes to mind, even when the evidence for the story is sparse and unreliable.”

  --Daniel Kahneman

Clinical vs Actuarial Judgment – the Motion Picture

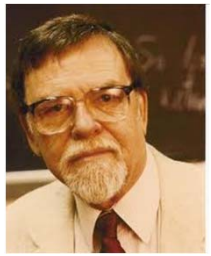
Science 31 March 1989:
Vol. 243 no. 4899 pp. 1668-1674
DOI: 10.1126/science.2648573

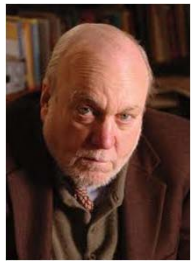
Clinical versus actuarial judgment

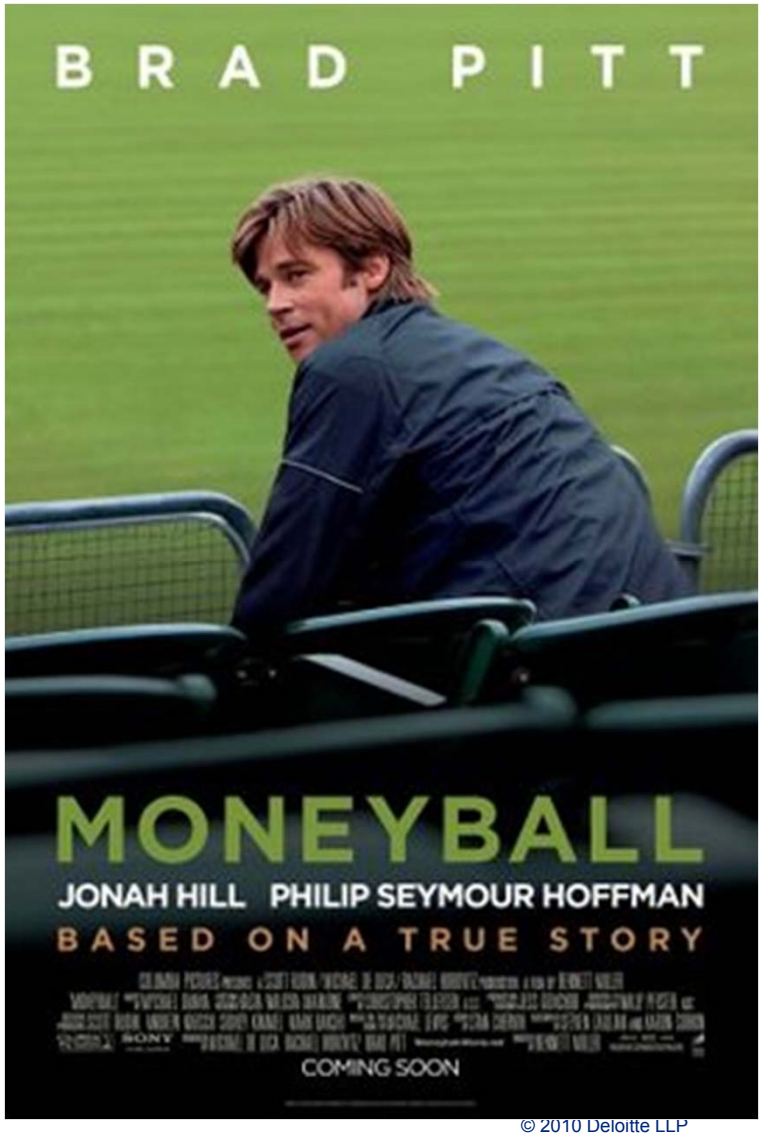
RM Dawes, D Faust and PE Meehl

ABSTRACT

Professionals are frequently consulted to diagnose and predict human behavior; optimal treatment and planning often hinge on the consultant's judgmental accuracy. The consultant may rely on one of two contrasting approaches to decision-making--the clinical and actuarial methods. Research comparing these two approaches shows the actuarial method to be superior. Factors underlying the greater accuracy of actuarial methods, sources of resistance to the scientific findings, and the benefits of increased reliance on actuarial approaches are discussed.







Analytics Everywhere

- Neural net models are used to predict movie box-office returns based on features of their scripts

- Decision tree models are used to help ER doctors better triage patients complaining of chest pain.

- Predictive models are used to predict the price of different wine vintages based on variables about the growing season.

- Predictive models to help commercial insurance underwriters better select and price risks.

- Predict which non-custodial parents are at highest risk of falling into arrears on their child support.

- Predicting which job candidates will successfully make it through the interviewing / recruiting process… and which candidates will subsequently retain and perform well on the job.

- Predicting which doctors are at highest risk of being sued for malpractice.

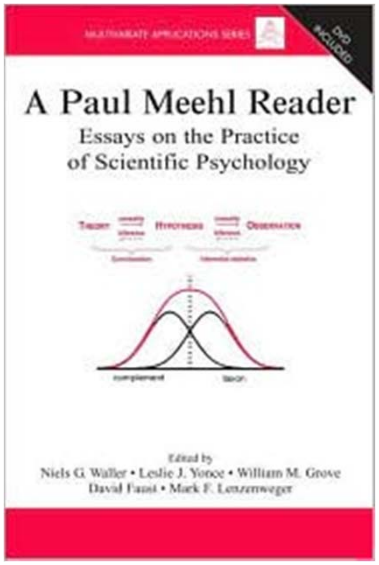
- Predicting the ultimate severity of injury claims.

(Deloitte applications in green)

A Practical Conclusion

"There is no controversy in social science which shows such a large body of quantitatively diverse studies coming out so uniformly in the same direction as this one. When you are pushing over 100 investigations, predicting everything from the outcome of football games to the diagnosis of liver disease, and when you can hardly come up with half a dozen studies showing even a weak tendency in favor of the clinician, it is time to draw a practical conclusion."

-- Paul Meehl, "Causes and Effects of my Disturbing Little Book"



Further Thoughts

The Importance of Defaults

- A important manifestation of “irrationality”: the effect of defaults on the choices people make.

Motivating example:

- If deserts are placed at the end of a cafeteria line, people tend to load up on healthy food and go light on deserts.
- If deserts come first, they will tend to load up more on deserts.
- In either case they are free to choose what they want; but the order in which the food is presented affects their decisions.

- **Real example (Thaler):**
- The way people invest in retirement savings accounts is heavily influenced by the defaults used in their companies’ retirement plans.
- Automatic enrollment (with opt-out option): people save more.
- Zero default (with opt-in option): people save less.
- Implication: merely changing a plans default “nudges” people to save more for retirement.

Fraught Choices and Insurance

- The insight about defaults is especially important in the context of what Thaler and Sunstein call “fraught choices”.

- **Fraught choices** are:
  - Complex and/or require specialist knowledge
  - Made infrequently
  - Have very slow “feedback”
  - Have important consequences, but only in the future

- Examples of fraught choices:
  - Life insurance, amount of insurance
  - Savings
  - Disability insurance
  - Health / catastrophic health insurance

Using Analytics for Custom Defaults and Product Mixes

- Appropriate defaults are therefore especially important for long-term insurance and savings decisions.

- Here “defaults” are:
  - Type of life insurance product (term, whole-life, etc)
  - Amount of insurance
  - Other insurance products (disability, health, personal auto/home…)
  - Savings / investment products

- Different combinations of options will be appropriate for different customers.

➔ Perhaps data analysis and predictive models can be used to suggest an appropriate default set of products/options for each customer.