

UNDERSTANDING BEHAVIORAL ECONOMICS: A QUALITATIVE PERSPECTIVE

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PREFACE

“...the crisis should motivate economists to think further about their modeling of human behavior. Most economic researchers continue to work within the classical paradigm that assumes rational, self-interested behavior, and the maximization of “expected utility.”
(Bernanke, 2010)

This book constitutes the lectures we prepared over the last few years for the upper-division course in Behavioral Economics we have both taught at the University of New Haven. It is intended to be used in class alongside a set of readings, a collection of PowerPoint decks, various videos, and a few movies.

Among our pedagogical objectives we have tried to convey to our students what every economist understands: Economics is a social science. Economists tread happily across any number of fields, to the point where we are often accused of intellectual imperialism. Behavioral economics started for the most part, in psychology – and has spread rapidly into all economic and business domains as well as to other fields such as forensics, intelligence, health. It appears that they are now returning the favor.

Behavioral economics is a vibrant and increasingly relevant subfield. It is one that embodies a relentless inter-disciplinarity. Behavioral economics embraces sociology, psychology, neurobiology, anthropology, happily alongside game theory, marketing, management, finance, and classical decision-making.

The Economics program at the University of New Haven is housed in the Pompea College of Business; and it is because we are within the business school that we face a unique challenge. Our task, as we see it, is to introduce our students to behavioral economics so as to enhance their analytical, and decision-making skills. We must reach non-economists and we must also reach those from across campus, from Music, Forensics, and Engineering.

What does this entail? Steven Pinker tells us that markets are “*cognitively unnatural*” and Gary Marcus observes that “...*humans didn’t evolve to think about numbers, much less money.*” Both keenly insightful observations and a tell. Our task is to explain a discipline built on an inter-disciplinary understanding of humans’ cognitive and evolutionary limitations to enable business and non-business students to overcome their cognitive and evolutionary limitations.

In his 1998 book, *Consilience: The Unity of Knowledge*, E.O. Wilson ambitiously proposed nothing less than to explain the whole of human experience in terms of the natural sciences. Beginning with the premise that we are biological beings, Wilson attempted to make sense of society, the arts, ethics and religion in terms of our evolutionary heritage. “I remember very well the time I was captured by the dream of unified learning,” he wrote. “I discovered evolution. Suddenly — that is not too strong a word — I saw the world in a wholly new way.”

Wilson claims that we can engage in a process of “consilience” that leads to an intellectually and aesthetically satisfactory unity of knowledge. So, we summarize and try to convey the powerful ideas of the many authors that have contributed to behavioral economics. These lectures are delivered in the spirit of consilience, attempting to draw insights, explanation and common sense to the confounding experiences in our business and other worlds.

The lectures in this book replay the ideas and writings of many. We try to be faithful and complete, but, occasionally, as Jorge Luis Borges once observed, “the original is unfaithful to the translation.” Which is a roundabout and more elegant way of saying there is not much sparkling new in these lectures except, perhaps in the way the material is stitched together.

Because of the varied and diverse crowd assembled – and because the nature of the field warrants it – we must de-emphasize the traditional focus of economics on mathematical modeling without sacrificing soundness and, especially, an understanding of the

material. Where does that leave us? In true and tried tradition: We split the difference. Here is the book in brief.

It is difficult to convey the implications and considerable insight of behavioral economics if our audience does not have a general understanding of conventional economics. Thus, we start by explaining the basic economic assumption and its considerable reach. We then proceed to acknowledge the limitations of conventional theory – first by recognizing the generality of strategic uncertainty – that is to say, the understanding that most of the outcomes we confront in our lives are the result of joint interactions with one or several counterparties.

The second fundamental step is to recognize that we also confront cognitive uncertainty, that – somewhat paradoxically - because of the heuristics embedded in us to enhance our decision-making capacity, we often make wrong decisions.

There is a certain beauty in a general theory. But there are also considerable shortcomings in its predictive reach. These shortcomings often arise out of our inability to recognize theory and models as merely first steps in an inquiry. Embracing behavioral economics will provide us with smaller, though significantly useful, explanations in exchange for a grand theory.

In seeking to understand the working of heuristics, we naturally recognize that mental schemas and cultural factors are determinants of economic outcomes. Moreover, economic outcomes often depend on heuristics in much the same way as they depend on our understanding (and reaction) to counterparties.

Mental schemas are powerful filters of information. Howard Zinn wrote once:

There was a moment in our lives (or a month, or a year) when certain facts appeared before us, startled us, and then caused us to question beliefs that were strongly fixed in our consciousness – embedded there by years of family prejudices, orthodox schooling, imbibing of newspapers, radio, and television.

It doesn't take long to recognize that mental schemas and cultural factors are forged and transmitted via cultural norms and social institutions – and in turn, forge and transmit cultural norms and institutions.

Thus, to fully grasp the relevance of norms and institutions, we have to understand the evolutionary design underscoring their formation and evolution - and of their persistence, their path-dependence to use the term of art. Relatedly, we also specifically have to understand the role of beliefs, how they form, the importance of emotions, and the role of chance and their relevance for social norms.

When it's all said and done, we end up with an awareness that the economy at hand, the one we want to understand, is a complex, self-organizing human system susceptible to change and by no means immune to the vagaries of chance. And, importantly, we recognize that we have evolved a deep sense of right and wrong to elevate and single out our proclivities for reciprocity and cooperation and its complement: discouraging and punishing excessive selfishness and free riding.

So, our task, to be simplistic, is to understand human nature. For human societies mirror our human nature. Toward the end we take up a couple of topical issues: Lessons drawn for moral issues and importantly, the relevance of behavioral economics for policy administration, analysis, and change.

Notes

Accusations of economic “imperialism” followed the work of the influential Gary Becker, The Economic Approach to Human Behavior (Chicago: University of Chicago Press, 1976). We point to Becker’s work on the economics of the family and more generally his contention as to the applicability of neoclassical methods to all aspects of human behavior.

See also, on the accusations: Kurt W. Rothschild, “Economic Imperialism,” *Anlyse & Kritik*, Vol. 30 (2008) pp: 723-733. [The term imperialism refers to the claims and attempts to show that the methods used in neoclassical economic theory should be exemplary for all social sciences] at 723.

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LECTURE I: OVERVIEW

The object of our analysis is, not to provide a machine, or method of blind manipulation, which will furnish an infallible answer, but to provide ourselves with an organized and orderly method of thinking out particular problems.
John Maynard Keynes, 1936.

Isn't "behavioral economics" a redundancy? Economics, after all, has built a sophisticated, cohesive machine aimed at understanding and presumably, predicting individual and social (i.e. collective or aggregate) behavior. Orderly and organized; Keynes would be proud.

Individuals respond to incentives (and disincentives); if not the first takeaway in an introductory Economics class, is certainly among the first. If you provide a reward for an action, more people are likely to consider and take the action. Importantly, you can draw policy conclusions from this analytical – and testable – insight.

If you alter the relative prices of two products I am considering consuming, it is likely that my choices will be affected accordingly. Coffee comes easily to mind, for I consume copious quantities daily. Thus, if the price of coffee increases, I will probably consume a little less. Once we aggregate across all coffee consumers, I predict that sales of coffee are likely to decline; relatedly, the sales of tea, or soft drinks, or juice – whatever is considered a substitute for coffee – might increase. They increase as people ("economic actors") opt for tea, or juice, or Coke instead of coffee.

Consider highway or bridge tolls as another example of how people respond to incentives and disincentives. Traffic tolls tend to vary according to the volume of traffic using the particular highway or the bridge. In many locations, new technology has made it practical for tolls to be higher during peak driving times and lower at all other times. The beauty of the mechanism is that it allows people to self-select and choose whether to pay a particular toll amount after

comparing the particular benefits to be gained to their individual costs – which include both pecuniary and opportunity costs – of driving at peak hour.

The list of fine analytical and predictive accomplishments goes on and on. But as it turns out, economics as a predictive science flubs it sometimes; and sometimes flubs it systematically. And, it flubs it for individual choices just as badly as it does for collective or social choices...because we have discovered that humans don't actually make choices – decisions – the way they ought to. As humans, after all, we live on Earth, not the planet Vulcan.

How do we improve decision-making? One way would be to chastise and hector everyone to be judicious and follow the recommendations of their cost-benefit analysis. Thou shalt not play the lottery!!! Economists do that a lot. But nobody listens to economists and people play the lottery anyway.¹

Another approach to improving decision making is to first understand why people buy lottery tickets. And once that step is taken, appraise how people *actually go about making* a decision rather than telling them how to they *ought to make* decisions, we are on our way to improving our explanatory and predictive capabilities.

We will not chuck mainstream economics. In fact, as we will see, economics has a history of engaging challenges – and it emerges none the worse for wear. We expect the behavioral revolution to be the same: it will foster a reckoning that will strengthen our analytical and predictive skills.

How are we to proceed? We look at how people acquire information, act strategically, are susceptible to emotion, and routinely simplify complex decisions. We will examine the nature of randomness and causality; how we are able to discern patterns amidst pure randomness and how we are predisposed to infer causality even

¹ We could also incorporate a variable to account for pleasure, fun, or satisfaction derived from playing the lottery into our demand function for lottery tickets. But this has a tautological flavor: Since we are assuming that playing the lottery is fun, what we conclude is that people play the lottery because it is fun.

when there is none present. We will recognize that experiences are often poor guides to future decisions. We explore how we overvalue and undervalue things.

After understanding individual behavior, we shift focus to examine how groups make decisions. Groups are often accurate when arriving at decisions, especially when the members are intellectually diverse and think independently. But we will analyze how changes in the composition of groups or alterations in their intra-group communication can make group-decision making worse and how cascades and herding behavior confound the wisdom of the crowds.

This is the wheelhouse of behavioral economics. We focus on the tools that have been devised to enable us to manage – if not overcome – decision-making pitfalls. These tools are popular with government agencies, marketing and advertising specialists, corporate managers, and other institutions.

By now, knowledge about behavioral heuristics and biases are exceedingly commonplace. The bestsellers and Ted Talks by Dan Gilbert, Dan Ariely, Joshua Lehrer, Massimo Piatelli-Palmarini, Daniel Kahneman, Michael Shermer, Gary Marcus, and Richard Thaler have popularized the commonplace understanding of these heuristics to the point where many have become popular after-dinner conversation gimmicks.

Our main task is to understand behavioral economics broadly. Since quite a bit of behavioral economics stands as a departure from conventional, mainstream economics, we can take the opportunity to review our conventional, theoretical framework.

But beyond our survey of the field, we are going to focus on policy. We are also going to proceed expansively by treating and pondering interesting and enticing questions in business domains – including, for the hell of it, the relevance of the increasing appeal of data analytics and artificial intelligence.

And as to the last point, consider the following. The central question in the movie *Ex Machina* - can a machine exhibit the intelligence indistinguishable from that of a human? -- is what is

known as the Turing test. The Turing Imitation Test is intended to establish whether a machine has achieved human-level intelligence.

Specifically, a person attempts to determine whether he or she is conversing (via text) with a human or a machine. The test has been criticized as being inadequate. At its core, critics argue, the Turing Test measures a human's ability to judge deception: Can a machine fool a human into thinking that it too is human?

The movie stars a fetching robot named Ava. Caleb, one of the film's protagonists, is charged with probing Ava's humanness. Indeed, the movie is so powerful in probing that question that in one especially compelling scene, Caleb is so entirely convinced that he begins wondering whether he is himself, also a machine. Was Ava's appeal in part her attractiveness and seeming vulnerability and innocence? Features that triggered evolutionarily baked-in responses within Caleb – and us.

During the summer of 2014 a computer program named Eugene Goostman passed the Turing test. It convinced 33 percent of the judges present that it was human [the established “threshold” was 30 percent]. Goostman prevailed in part, one could argue, by presenting itself as a 13-year-old Ukrainian boy. One must wonder, whether the assignment of gender, a young age, and being ascribed a foreign-origin [where was Goostman presented? Presumably not the Ukraine?] benefited Goostman. These attributes would benefit Goostman by appealing to the judges' subjective affection on the matter of gender, age, and national-origin, allowing “Eugene” to perform a convincing imitation of a human. Indeed, after all, we see what we want to see.

But the question is not so much what populates the judges' decision-making apparatus. We need to determine the nature of the cognitive biases that we would “program” into a Turing Test candidate.

Everyone makes mistakes, especially young'uns. Thus, to be convincing our candidate has to make mistakes. But errors derived

from cognitive biases are not the same as other errors, such as logical errors...although “humans” make logical errors also.

It is important to distinguish between cognitive biases and run-of-the-mill errors. There are errors derived from improper logical arguments. Errors attributable to cognitive bias, on the other hand, are genuine instances in which decision-making shortcuts are taken out of context.

Perhaps you are wondering why we would have built-in attributes (i.e. heuristics) that would harm or even kill us. Evolutionary psychologists believe our cognitive biases are life-preserving adjustments to information processing limitations, especially useful traits in dangerous situations. Still, even though we may be prone to errors in judgment, we can be aware of them.

There is more to the movie. It is interesting to see all that Caleb “projects” into Ava’s actions and behavior. And, as another protagonist, Nathan, confirms, he programmed Ava to elicit this response from Caleb.

He need not have. Our species may be the only one able to conceptualize mental states. And although there is some sense that other species, such as chimps, dogs, and dolphins, may have some modest capacity in this regard there is absolutely no question that we’re much better at it than the rest of the animal kingdom.

“We are natural psychologists,” according to Jessie Bering, “evolutionarily selected to be attuned to the unseen psychological world. Reasoning about abstract mental states is definitely a human trait, indeed right up there with walking upright on two legs, learning a language, and raising our offspring into their teens. There is a scientific term for this way of thinking: ‘theory of mind.’”

Indeed, here is how Bering explains it in this abridged excerpt from his recent book: *The Belief Instinct*.

It's perhaps easiest to grasp the concept when considering how we struggle to make sense of someone else's bizarre or unexpected behavior. If you've ever seen an unfortunate woman at the grocery

store wearing a midriff-revealing top and packed into a pair of lavender tights like meat in a sausage wrapper, or a follicularly challenged man with a hairpiece two shades off and three centimeters adrift and asked yourself what on Earth those people were thinking when they looked in the mirror before leaving the house, this is a good sign that your theory of mind (not to mention your fashion sense) is in working order. When others violate our expectations for normalcy or stump us with surprising behaviors, our tendency to mind-read goes into overdrive. We literally "theorize" about the minds that are causing ostensible behavior.

The evolutionary significance of this mind-reading system hinges on one gigantic question: Is this psychological capacity—this theory of mind, this seeing souls glimmering beneath the skin, spirits twinkling behind orbiting eyes, thoughts in the flurry of movement—is this the "one big thing" that could help us finally understand what it means to be human?

We have a tendency to attribute personal agency to objects, to treat an abstraction as a real thing – a trait known as *reification*. This cognitive bias to see intentions in inanimate objects was demonstrated as early as 1944 in a study by Fritz Heider and Mary-Ann Simmel.

Heider and Simmel shot a short film clip featuring three moving, black-and-white figures: a large triangle, a small triangle, and a small circle. Those watching the figures moving about on the screen were asked to describe what they had just seen.

In their explanations, most viewers resorted to human social behavioral narrative. And any modern-day viewers would probably do the same. We would identify with the smaller triangles (the underdogs), attribute meanness to the large triangle, convinced that the large triangle was "bullying" and prosecuting the smaller, defenseless smaller triangle, both of whom were seeking the affections of the female circle.

In the next lecture we start examining the decision-making process.

Readings

The Turing test was proposed by Turing in his 1950 paper, "Computing Machinery and Intelligence," in which he considered the question, "Can machines think?" The definition of think, or, more explicitly "intelligence" was instrumental. A computer is deemed intelligent if it acts intelligent. Thus, Turing proposed an "Imitation Game," in which a machine, communicating with a human interrogator via a "teleprinter," attempts to convince the interrogator that it (the machine) is human. Turing predicted that by the year 2000 it would be possible to fool an average interrogator with probability of _____ at _____ least _____ 30%. See: <http://m.cacm.acm.org/magazines/2014/9/177937-would-turing-have-passed-the-turing-test/fulltext>

For a great introduction to the class read Justin Fox "From 'Economic Man' to Behavioral Economics," Harvard Business Review (May 2015).

The orthodoxy is giving ground neither theoretically nor empirically. Here is a champion of rational man, read:

Daniel Ben-Ami over at Spiked-online, "[In Defence of Rational Man](#)."

Perhaps the greatest classic in describing the notion of reification is the video by Fritz Heide and Marianne Simmel.

[Fritz Heider and Marianne Simmel. Experimental study of apparent behavior.](#)

And,

[Read Jesse Bering on Theory of Mind in Slate.](#)

Please scan the following papers:

Blanton & Gerard, "Effect of Sexual Motivation on Men's Risk Perception of Sexually Transmitted Disease: There Must be 50

Ways to Justify a Lover,” *Health Psychology* V.16, No.4 (1997) pp: 374-379.

Ditto, Pizarro, Epstein, Jacobson, and Macdonald, “Visceral Influences on Risk-Taking Behavior,” *Journal of Behavioral Decision-Making*, Vol. 19 (2006) pp: 99-113.

Question: by pointing to the research discussed in the papers by Blanton et al. and Ditto et al, discuss the degree to which our choices do not follow from purely rational “considerations.” What emotions are involved?

Resources

[Jessie Bering in Slate.](#)

[David Barash \[this looks like an article\]](#)

[Fritz Heider and Marianne Simmel. Experimental study of apparent behavior.](#)

[Conchita Wurst](#)

[Maria Konnikova](#)

[Stephen Asma](#)

LECTURE II: RATIONALITY

Someone pointed out that blaming economic crises on “greed” is like blaming plane crashes on gravity. Certainly, planes wouldn’t crash if it wasn’t for gravity. But when thousands of planes fly millions of miles every day without crashing, explaining why a particular plane crashed because of gravity gets you nowhere. Neither does talking about “greed,” which is constant like gravity.
Thomas Sowell

North of the University of New Haven is a motor parkway which runs east-west. It is called the Merritt Parkway, and on any given October it offers breathtaking views of the fall turning-of-the leaves.

The Merritt Parkway was built in the 1930s, designed to carry significantly less traffic than it does today. Horror stories are commonplace for commuters who must travel the parkway. Commuting savviness is judged by one’s understanding of traffic flows and peaks. A common greeting today around here is, “How was your commute today?” The question elicits pained expressions. Still, despite its warts, there are times when you can drive pretty fast on the Merritt.

Imagine yourself hurtling along the Merritt parkway at a fast clip. And the signage informs you that you are cruising by one of the many towns that border the parkway. Suppose you see one of the intakes ahead of you, a long line of cars waiting for a break in the traffic, the chance to merge onto the flow of traffic. Peculiarly – perhaps a standard parkway architecture practice back in the 1930’s – most of the intakes do not have any meaningful merge lanes. Drivers seeking to enter find themselves at a full-stop, often at a 90-degree (or slightly less) angle to the parkway, with a mere few feet of pavement in which to accelerate from dead-stop into the 60-70 mph barrage of automobiles.

As you blow along at 70 mph your Spidey-sense immediately perks up because at this point you cannot slow down to accommodate someone entering – the \$%^ driver behind you can practically reach

up and touch you. And you cannot move onto the left lane because it is filled with cars going even faster than you are.

You look ahead and try to somehow telescope your eyes into the cabin of the car awaiting to enter. You do this instinctively, trying to discern the driver's intentions; if only you could actually see his eyes!! Is he going to recklessly jump in front of you risking a dangerous collision or, at the very least, a severe violation of Connecticut highway etiquette and norms?

There is much in this split-second interaction. This is an example of a moment where you have to draw inferences (in this case, as to the driver's intentions) in order to make a decision. And inevitably, you assume that given the available cues and information the driver is unlikely to drive into traffic because the likelihood of an accident is far greater than the benefit of waiting a bit.

In doing so you have probably relied on a heuristic: Something tells you to proceed, that you need not fear – too much – a sudden jump from the waiting car. You have avoided the recommended decision-making mechanism taught in introductory economics and ingrained as the only official “rational” way to make a proper decision: which is to add-up the costs and benefits of the intended action; to assume that the individual considering jumping into traffic has no other interest but to look out for number one. You have implicitly assumed that the agent is rational.

We know that the rationality assumption has been at the epicenter of the behavioral economics onslaught; in fact, that's why we are here – to review and understand that criticism. One of the first steps is to try to determine when, where and why we sometimes rely on gut, quick, often reactive decisions and at other times we resort to a ponderous, more deliberate, dispassionate approach.

This duality of decision-making capabilities that we have is Daniel Kahneman's System 1 and System 2. System 1 is automatic, immediate, and, importantly, effortless. System 2 is a ponderous, deliberate process that requires time, concentration and cognitive effort – and often only to justify the impulsive decisions of System 1.

Just as most people when faced with an alternative that requires more energy will opt for the one that demands the least amount of energy necessary, such as driving when you could walk. A similar “path of least resistance” also applies to people’s cognitive effort.

The Merritt Parkway tour we provided above is to give you a sense of the presence of the existence of these two systems and the underlying machinery that spurs into action unbeknownst to you. To exaggerate a bit, for sake of pedagogy: We were aiming to describe a life or death situation. A situation where it would have been impractical to stop and take a moment to tally up the costs and benefits of speeding up or slowing down, – to say the least.

At moments like that where time is of the essence, the instantaneous System 1 mechanism, what we know call decision-making heuristics spring into action and take over.

System 1 is more influential than your experience tells you, and it is the secret author of many of the choices and judgments you make. (Kahneman, at 13)

Most of our thinking and deciding is based on intuition and not controlled reasoning. And according to Pollack (2015) heuristics constitute “compressed” mental data. “One tactic that we use is to record information outside our brain in numbers, written words, images, and recorded sounds. Another tactic ... is remembering stories.” And it matters not whether the story is “true” or “accurate.” Again, Pollack (2015) “...it is the feelings and ideas they evoke that make them so powerful.”

The gimmicky life and death situation provided by the narrative is to highlight the importance of heuristics in keeping us alive. In fact, we are alive because we – as a species - developed the traits that we now call heuristics in our early appearances on the planet. Think about it in evolutionary terms. Roll back to way yesteryear when we lived in the African savannah. If you heard a rustle in the bushes and you learned to associate that rustling to danger – your chances of

surviving to seed the next generation were greater than your fellow tribe member who did not have that association. So, you lived; he died. And you lived to pass on that survival trait; and on, and on.

For our purposes, the narrative highlights the relevance of cognitive constraints, in the sense of limiting the usage of caloric energy, and time constraints. If you seek to understand why we can resort to this “life-preserving” heuristic, you may recognize the Darwinian notion of evolutionary fitness. This is of course the main point in Richard Dawkins opus: *The Selfish Gene*. Dan Dennett talks about Darwin’s dangerous idea – and more pointedly on Darwin’s “strange inversion of reasoning.”

Here, then, per Dennett, is Darwin's dangerous idea:

the algorithmic level is the level that best accounts for... the diversity of species, and all of the other occasions for wonder in the world of nature. ...No matter how impressive the results of an algorithm, the underlying process always consists of nothing but a set of individually mindless steps succeeding each other without the help of any intelligent supervision. (p.59)

Dan Dennett is also known for the concept of “intuition pumps.” We will come back to the matter of intuition pumps later. In the meantime, given that the concept of rationality is key in this entire debate, let’s make sure we understand what “rationality” IS and what it is NOT.

Rationality: What it is or isn’t

In our culture, in our lives, rationality is considered a virtue: something to which we should aspire; something to be emulated and instilled in our young. We admire Sherlock Holmes and Spock because they are dispassionate, unemotional, detached, efficiently distant, deliberate, even a little cold, albeit in a cool, hip way. By contrast, we hurl the term, “irrational” at someone with intent to be disparaging, even hurtful.

But “rational,” for the task at hand, simply means consistent with some model. In fact, rational decisions are not necessarily dispassionate, nor well-reasoned, nor selfish. They aren’t even good decisions from the perspective of others. They are simply *consistent*. Consistency is an appealing criterion. A rational individual should always prefer better things to worse things – more of a good thing to less – and to do so systematically and predictably. The rational individual is able to assess which choices lead to a more desirable outcome. In the language of economics, the individual should anticipate how much value – *utility* – would come from his/her choices and to opt for the alternative that maximizes his/her utility. In other words, to establish how much he/she benefits from a particular outcome. Relying, then, on that (rational) assessment, decision-makers should be able to distinguish which choices lead to more desirable outcomes. If unable to determine whether one choice is preferable to another, then he/she is (assumed to be) able to remain indifferent among the choices. Formally, we say that a rational individual should reliably make choices that maximize his/her utility.

In the rational economic model, the individual compares the satisfaction of the choice before her with the dollars she is being asked to expend for it; we assume she knows how she will feel if whenever she opts for either choice. Importantly, we feel that, given a choice of A or B, there are three simple alternatives: We either prefer A to B, prefer B to A, or we are indifferent between the two choices. This property of rationality is referred to as *consistency*.

Further, given choices A, B, and C, if we prefer A to B and prefer B to C, then it must be true that we prefer A to C. This property of rationality is called *transitivity*.

That’s it. It’s that simple. As a matter of fact, this simple model with these simple assumptions is hugely powerful. It provides a good sense of what we choose to do when prices rise. Indeed, it is so powerful that it has been readily adopted by the other social sciences and deployed for the analysis of complex social phenomena. Thus, we can understand how criminals respond to enhanced police

measures, how people react to higher prices of gasoline, and how students will respond to more onerous grading policies.

Much of the criticism regarding the assumption of rationality arises largely from a misunderstanding of what “rationality” refers to in economic and social science theory; confounding this meaning with the everyday usage of the word.

Thus, an initial misconception is that everyone shares our definition of the word rational. Rational choice models do not assume anything about what a decision-maker *prefers*. Importantly, the theory is silent on morality: Rational Choice Theory does not strive to determine what a person SHOULD prefer, according to some moral or ethical code. The desire for A’s, B’s, and C’s are given. Rational choice models only state that those preferences consistently lead to choices – and that choices are transitive. So those seemingly contradictory acts of giving of ourselves, our time, our money, without expecting anything in return may be rational. The key is that we also derive utility from the outcomes experienced by others.

A second misconception is that a rational choice maker must be completely selfish, lacking in altruism. Rational choice has nothing to do with an individual’s preferences or the societal benefit of these choices; only that the preferences lead to consistent and transitive choices.

A third misconception is that rationality refers to the decision *process*. Rationality refers to the *outcome* of decisions of choice. By *assumption*, utility is derived from the outcome of choice. It is independent form the process of choice. Rationality has nothing to do with the nature or logic of the process. REM is an “as if” model. As if models predict outcome rather than the process of decision-making.

Milton Friedman provided us with the famous exposition of the *as if* argument. Friedman used the analogy of a snooker player who does not know the geometry of the shots he makes. Yet the player behaves in close approximation to how he would if he did make the appropriate calculations. We could therefore model the snooker player’s game

by using such equations, even though this wouldn't strictly describe the mechanics of the game.

In fact, here is Friedman:

Consider the problem of predicting the shots made by an expert billiard player. It seems not at all unreasonable that excellent predictions would be yielded by the hypothesis that the billiard player made his shots as if he knew the complicated mathematical formulas that would give the optimum directions of travel, could estimate accurately by eye the angles, etc., describing the location of the balls, could make lightning calculations from the formulas, and could then make the balls travel in the direction indicated by the formulas. Our confidence in this hypothesis is not based on the belief that billiard players, even expert ones, can or do go through the process described; it derives rather from the belief that, unless in some way or other they were capable of reaching essentially the same result, they would not in fact be expert billiard players.

It is only a short step from these examples to the economic hypothesis that under a wide range of circumstances individual firms behave as if they were seeking rationally to maximize their expected returns (generally if misleadingly called "profits") and had full knowledge of the data needed to succeed in this attempt; as if, that is, they knew the relevant cost and demand functions, calculated marginal cost and marginal revenue from all actions open to them, and pushed each line of action to the point at which the relevant marginal cost and marginal revenue were equal. Now, of course, businessmen do not actually and literally solve the system of simultaneous equations in terms of which the mathematical economist finds it convenient to express this hypothesis, any more than leaves or billiard players explicitly go through complicated mathematical calculations or falling bodies decide to create a vacuum. The billiard player, if asked how he decides where to hit the ball, may say that he "just figures it out" but then also rubs a rabbit's foot just to make sure; and the businessman may well say that he prices at average cost, with of course some minor deviations when the market makes it

*necessary. The one statement is about as helpful as the other, and neither is a relevant test of the associated hypothesis.*²

Why Misconceptions?

Now that we know what rationality is and is not, and why it is useful, let's recap. To an economist, rational decisions are not about selfishness. Nor do rational decisions require Spock's discipline and precise thinking. They aren't even necessarily good decisions, from the perspective of others. We can talk about a rational criminal. Such a being is one who opts to choose a particular criminal act over another as a result of increased policing in one area. Or rationally breaking a contract: such as walking away from an underwater mortgage. This makes sense because the cost of fulfilling the terms of the contract are more onerous than severing the agreement.

For most people these examples are, if not forbidden, normatively frowned upon. Our sense of morality prevents us from equating the walking away from a contractual arrangement to choosing an apple over an orange; and similarly, our understanding of the "evilness" of crime limits our ability to view criminals as "rational" human beings.

Our favorite example of the clash and contradiction that often arises between the recommendations derived from economic reasoning and the reality of everyday heuristic-informed life is the typical outlawing of price-gouging that inevitably occurs whenever we face – and after we have lived through - a natural disaster. In the aftermath of disaster, scarcity prevails. Economic theory dictates that there is a greater likelihood that products would be resupplied if prices were to increase to reflect the underlying scarcity. In other words, it makes perfect economic sense to let prices rise after a storm or hurricane. But the increasing of prices doesn't often happen. And if it does appear it is quickly demonized - and often criminalized. In fact, in this day-and-age where we can anticipate with some precision

² (Friedman, 1953), pp.12-13.

the arrival and impact a storm, prices should go up *in anticipation* of a storm. Yet this does not happen either. Were a merchant to jack-up the price of milk, or candles, or canned goods – as sound economic theory advises – there would be hell to pay, today and tomorrow; he would be “punished” by customers who feel this is “taking advantage of folks.” Repercussions for the violations of norms of “decency and fairness” could be considerable and lengthy; very few shopkeepers raise prices; they prefer to ration their product rather than raise their price.

This confounding of the term “rationality,” is natural. We tend to reason by analogy. This ability to idealize, to transfer the main elements of a scene or event triggers the “rich network of ideas, memories, and emotions that endow our experiences with contractual meaning and potential utility.” Paul Rubin rues the commonplace semantical misunderstanding of *markets* with *competition*, an effect he has coined, “Emporiophobia.” He rightly notes that the *raison d’être* of economics is to study the institutions and elements that are derived from trade, from transacting. And rather than a competitive one, trade is fundamentally a *cooperative* activity. And rather than a zero-sum game where it has to be true that for there to be a winner, there has to be a loser, markets are about creating value and wealth: a positive-sum game. In other words, the networks, practices, mores, cultures, institutions all that surround us are designed to facilitate, foster, encourage, and enhance trade so that the resulting outcome benefits us all.

This confounding of markets (cooperation) with competition is both unnecessary and destructive. Rational individuals and groups who realize they benefit from trade and want to trade are likely to cooperatively devise mechanisms to do so. Examples abound: Stock and commodities exchanges, shopping malls, e-commerce, etc. Indeed, the very rationale for the development of towns and cities is the need to cooperate to engage in trade.

We know that parties to a transaction often rely on personalized exchanges to facilitate trade. They benefit from the presence of

reputational capital and other informal mechanisms. For instance, the price differential charged by a seller may reflect in the cost of the commodity some particular feature of the business relationship. Embedded in the transaction price, for instance, may be an implicit financing charge or, perhaps, an adjustment for an exclusionary agreement. Or there may be a commitment by the seller to absorb some of the downside risk—a promise to “take care of the buyer” when prices decline. In other words, transactions are likely to incorporate relationship-specific circumstances derived from the nature of personal transactions.

Since Macaulay, it has been recognized that some measure of assurance and predictability can be supplied to markets via informal means. Throughout history and to this day, small, stable, social networks provide the necessary context for the reliance on informal social relations and norms, and informal sanctions to negotiate and enforce agreements.

These arrangements sanction individual actions by rewarding or punishing alternative courses of behavior. These collaborations could be traditional “middleman” ethnic or tribal associations. Thomas Sowell, among others, has described in detail the necessity for, rise of, and occasional discrimination to the point of violence done to “middleman minorities” in countless societies. Or, and often with some overlap, the collaborations can be trade groups, industry groups, regional groups and even political, party-affiliated groups. Their prosperity is attributable to commercial networks and informal, often highly efficient capital and managerial markets based on common ties and the group’s reserve of social capital. Wright et. al., for instance, describe the different roles of social capital and networks in facilitating entry into emerging versus developed economies by emerging economy firms (Wright, Filatotchev, Hoskisson, & Peng, *Strategy Research in Emerging Economies: Challenging Conventional Wisdom*, 2005). In emerging and transitioning economies, non-market capital, such as political capital, and social

capital is likely a more important means for firm diversification and growth than is market capital such as brand awareness, among others.

It is important to note that economic exchange sustained largely by personal relationships of trust and reciprocity can impede the development of a functioning impersonal market economy if no interaction outside the group is possible. If exchanges are limited to reciprocal ones, the number of prospective partners is limited and the search costs for finding a partner will be high. These limitations do not create the political and economic institutions that foster cooperative activity in impersonal exchange settings.

As we move forward, rationality will be under examination; as will the naturally evolved institutions that are necessary to support trade. In the next lecture we review elementary evolutionary theory and then we turn to the classical model of economic choice.

Readings

The discussion is over the fundamental theme in Transaction Cost Economics; non-standard agreements reflect the reduced the cost of transacting, accounting especially for the anticipated costs of opportunism derived from relationship-specific investments. As such, their presence reduces the cost of conducting economic activity.

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North, D. C. (1990). *Institutions, Institutional Change and Economic Performance*.

Pollack, J. (2014). *Shortcut*. New York: Penguin Random House.

Paul H. Rubin, *Emporiophobia (Fear of Markets): Cooperation or Competition?* PRESIDENTIAL ADDRESS, SOUTHERN ECONOMIC ASSOCIATIONS, TAMPA, FL, NOVEMBER 23, 2013.

Thomas Sowell, *Black Rednecks and White Liberals*, Encounter Books, June, 2005, [chapter 2](#).

Williamson, O. (1985). *The Economic Institutions of Capitalism*.

Wan, W., Hoskisson, R. E., Short, J. C., & Yiu, D. W. (2011). Resource-Based Theory and Corporate Diversification: Accomplishments and Opportunities. *Journal of Management*, 37.

The orthodoxy is giving ground neither theoretically nor empirically.
Here is a champion of rational man:

Daniel Ben-Ami over at Spiked-online, “[In Defence of Rational Man](#).”

The Friedman fragment is from Essays in Political Economy (1953),
at 12-13.

Videos and Podcasts

Here is [Friedman on greed](#); a classic videocast.

LECTURE III: EVOLUTION & RATIONALITY – A PRIMER

*Many were increasingly of the opinion that they'd all made a big
mistake in coming down from the trees in the first place.
And some said that even the trees had been a bad move,
and that no one should ever have left the oceans.*

Douglas Adams, The Hitchhiker's Guide to the Galaxy

Contrary to the stark vision of the Tragedy of the Commons, Leviathan, or the Lord of the Flies, humans are not predisposed to live a “solitary, poor, nasty, brutish, and short” life, riven by self-interest with little care or compassion for their neighbors. Nor do we constitute “two distinct species of men, the good and the bad,” to continue in a Hobbesian/Golding frame.

To the contrary, humans seem to have an innate tendency to cooperate with one another if only because, dare say, it improves our lot. If you make war on the baker, you have to find another source of bread. Cooperation promotes genetic survival. Baboons are far more likely to survive when their mothers are socially involved with one another. Being cooperative makes members of a species more attractive as potential mates. The more attractive get more chances to procreate; the more likely the trait appears in their offspring. And so forth.

Cooperation is a precursor to trading. It is worth noting that trade alone is not sufficient to achieve modernity. It is necessary but not sufficient. In fact, modernity is perhaps a few centuries old whereas man has been present on earth – and trading – for considerably more than that. Michael Shermer estimates “that the age in which we live, and take for granted as normal and the way things have always been, in fact constitutes a mere one-quarter of one percent of the history of humanity.”³ But interestingly, this realization points to the relevance

³ (Shermer, 2005) p.3.

of social, collaborative institutions that are equally necessary for growth and the improvement of our lot.

Our ability to cooperate is one of the main reasons humans have managed to survive in almost every ecosystem on Earth. But, thanks to the work of countless sociologists, psychologists, and anthropologists, we now know of the cooperative urges ingrained in humans. And that we are taught by our culture, embodied in norms, traditions, and customs not only to play well with others but to shun, punish or even cast-out those that do not. The good book, folk tales, myths, yarns, narratives, are all replete with instructions as to who deserves rewards and who is to be punished.

And speaking of norms, it is illuminating to watch people queuing behind a ticket counter. Almost all of us are scrupulous about keeping our place in line, even with strangers we won't see again. It is considered "proper" behavior and, unless we are skiing in Quebec we would be mortified, nay, terrified, to be called out by someone accusing us of cheating or cutting in line. The queue brings up another side of our seeming instinct for cooperation, a complementary one. Cut into a queue and you'll soon learn just how highly *others* prize cooperation. And how much we hold in contempt those who cut into line. Those violators who willy-nilly break the rules. People who stray from "acceptable behavior" threaten the well-being of everyone else.

Cooperation seems to be an evolutionary anomaly. The continued existence of most species derives from *competition* for food, territory, and mates. Why would one individual go out of its way to help another? Have you ever said or thought, when facing a proposal that demands or requires something of you, "What's in it for me?" We all have. Nevertheless, as Gretchen Vogel puts it "the animal world has numerous instances of cooperation that seem to be hard-wired: bees that collect pollen for the whole hive, mole rats that build elaborate tunnels used by other group members, vampire bats that share blood

hauls, and meerkats that risk their lives to guard a common nest.”⁴ And despite our cynicism, we know many people who generously give, share, volunteer, and do so expecting little in return.

Cooperative behaviors are especially applicable when it comes to reproduction – and the passing of genes to the next generation. Hamilton’s kin selection theory (“blood is thicker than water”) showed how helping relatives can increase the chances that one’s own genes will be passed on through them.

The theory elegantly explains the behavior of cooperative insects, for example. Shortly after Hamilton, Robert Trivers developed a theory that explained why unrelated individuals might also be inclined to help one another – what came to be known as reciprocal altruism (“I’ll scratch your back if you scratch mine.”) Trivers’ work places the relevance of an individual’s reputation in center focus. And it prominently highlights the role of information transfer mechanisms. Having information, knowledge of someone’s reputation may facilitates cooperation by reducing the costs of placing your trust on someone.

The existence and diffusion of “information” – gossip, tales, narratives – can lead to the evolution of trust and trustworthiness. In the presence of institutions that facilitate the transfer of applicable information, humans are inclined to be trusting and trustworthy even when exchanges are entirely anonymous.

According to the theory of reciprocal altruism, helping a nonrelative increases one’s own fitness to the extent that we believe our counterparty will reciprocate – that is to say, that he will return the favor. An ingrained willingness to help those who would help you in return would have been beneficial in early human societies. Especially during the times when we lived in groups small enough for us to keep track of who cooperated with whom.

And, as mentioned above, perhaps the most interesting corollary is the reliability and energy with which we go to great lengths to

⁴ (Vogel, 2004)

punish those who abridge norms of behavior – like those who cut into line, those who lie, cheat or steal. Such norm-breaking actions are readily recognized and declared among nearly all societies as “dishonorable,” stimulating, thereby, serious sanctions, shunning, and punishments, both formal and informal. Often, we seek to punish, rebuke, or scold, even at the expense of imposing costs on ourselves, with no corresponding benefits.

So, can we conclude that we have “a fairness gene?” Perhaps not, but as a metaphor it probably reflects the fact that fairness is probably hardwired within us. Human survival and human flourishing rests on fairness and cooperation – and very much around *protecting* cooperation – *enforcing* the Golden Rule.

On the Emergence of Heuristics, Norms, Customs, and Cultural Practices

Random genetic mutations and the mixing of parental offspring produce variation. But it is the *selection* of this genetic variation by nature that drives evolution. We note above that these selected human practices exist to transmit genetic information. Complex processes emerge from this variation combined with cumulative selection.

The evolution of the practices we take for granted proceeded in an analogous manner through the production and selection of numerous permutations of practices that facilitate collaboration and trade. Examples include the way one shakes hands and whether one makes eye contact. How did a firm handshake, eye contact, the image conveyed by the clothes we wear, and so on become institutionalized? That is to say, how did they derive the power to act as “tests” to distinguish a person’s “trustworthiness?”

Again, these tests became accepted because they were life-preserving and life-extending. Or, to be more precise, as the evolutionary biologists say it, they are beneficial in the game of passing genes to the next generation.

Consider the grimace we form with our faces when we get a whiff of rank milk. Most of us choose not to drink from that bottle once the smell hits us. The whiff is a signal that informs us about the soundness of the milk. As with all signals that categorize or classify, two things can go wrong. Despite the pungent whiff the milk could be good and safe, yet you end up not drinking it...pouring it down the sink, and wasting a perfectly good source of protein. This is a false negative. (milk is sound, i.e. it is False that it is sour; sniff test says pungent or negative)

On the other hand, the milk could be spoiled but you choose to drink it anyway ‘cause you sniffed it and it seemed ok. And you become violently sick. This is a false positive. (sniff test returns OK, i.e. positive; and the milk is actually bad, False).

The kicker here is that the costs associated with these two errors are not the same. Drinking or eating putrid food in yesteryear killed people (sometimes it still does). Whereas mistakenly not eating good food merely resulted in the loss of a bit of food.

Thus, over time, those individuals that developed the ability to sniff out rank foods prevailed, and those who didn't, well, they died out. So, the trait – the ability to detect rank foods – is now an evolved human trait, a heuristic. And, so it is with any number of our heuristics. They emerged – and became institutionalized for easier transmission and diffusion – because they were life preserving or life extending.

And this is the case with mores, customs, and behaviors. They were singled out, selected for, and thereby preserved because they enhance something beneficial to us. As Francis Fukuyama observes, economic life is deeply embedded in social life, and it cannot be understood apart from the customs, morals, and habits of the society in which it occurs. In short, it cannot be divorced from culture.⁵

Further Questions

Explain the elements and analytical relevance of what John Tooby and Leda Cosmides call the *Banker's Paradox*.

READINGS

Martin Nowak, & Karl Sigmund, "Evolution of Indirect Reciprocity," *Nature*, Vol. 437, No. 27(October 2005), pp: 1291-1298

Martin Nowak, "Indirect Reciprocity – Power of Reputation," Chapter 2 in Martin Nowak with Roger Highfield, Super Cooperators, (Edinburgh: Canongate Books, 2011).

⁵ (Fukuyama, 1995)

Gretchen Vogel, “The Evolution of the Golden Rule,” *Science*, (February 20, 2004), pp:1128-1131 [this is an excellent precis]

VIDEOS

[Steven Pinker: Human nature and the blank slate](#) (TED TALK)

[Our Mind is Not a Blank Slate: Evolutionary Psychologists Leda Cosmides & John Tooby](#) (REASON TV)

You can see Dennett [here in a TED Talk](#) (short video) and [here at Google Talks](#) (longer video).

PODCASTS

The BBC has a great collection explaining Darwin, his ideas and legacy. You can find it [here](#); listen to the 3rd and 4th episodes especially.

LECTURE IV: ON METHOD

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.

Gary Becker
The Economic Approach to Human Behavior (1975)

Malcolm Gladwell's [insightful telling](#) of the experience of the innovative singer, Kenna, was illustrated by revisiting the story of the rise and fall of New Coke. The video is hugely entertaining, and provides numerous takeaways for us. It directly challenges the conventional belief that "there is no accounting for taste."

This constancy, this immutability of preferences – "preferences are exogenous" – alongside the stipulation that everything we do is to satisfy preferences was one of the fundamental tenets of conventional mainstream economics. It continues so for a great portion of the profession. Using these axioms and drawing from Friedman, people could, and should, be modeled as if they possessed consistent and transitive preferences which guide their behavior automatically. That is, human behavior is, for the most part, goal-directed behavior. Economics did not seek to understand *why* we seek to want and value what we do. Going back to our X's and Y's, choosing X over Y reveals a preference; no psychological explanation is needed as to why $X > Y$.

We now understand that markets and other economic and social institutions do more than allocate goods and services. We now know that they also influence the evolution of values, tastes, and personalities. And in this process, the context within which we interact and engage both structures the interactions in which we are involved and influences our decision-making.

There are other features of conventional economics worth understanding. A key one is *methodological individualism* – the idea that economic explanation must be sought at the level of the individual agent. And that the explanation must proceed from the agent to the structure. Again, we now know that the individual is a creature of its social context and that context matters – another key takeaway from the Kenna video.

Another, key, element of conventional economics is reliance on the concept of *equilibrium*. An economic system is considered “in equilibrium” if economic variables do not change in the absence of an external influence. Questions surrounding conventional economics amount to inquiring about departures from equilibrium and, importantly, the extent to which the system is stable. Which is to say, whether it is capable of returning to an equilibrium position.

Scarcity and the Problem of Economics

Economics confronts a fundamental problem: Scarcity. Everyone wants more “stuff” than there is to go around. Market economies deal with this problem by confronting individuals with the costs of producing what they want. Importantly, the market lets those individuals make their own trade-offs among the various alternatives when presented with prices that convey those costs. That leads to self-rationing, in the light of each individual’s own circumstances (ability to pay) and preferences (willingness to pay). It also provides us with a decision-making framework from which to draw numerous predictions.

Consider the following stylized example. Suppose you are stranded in a desert island. You can do one of the following things: you can look for food, make a fire, or build a shelter. Each of these outcomes provides you satisfaction, or to use the term of art, utility. Importantly, the utility that you derive from the outcome of choice is independent of the process of choice. Thus, you may favor the

outcome where you eat fish. But you do not favor it *because* you enjoy fishing.

Formally, an ordering of preferences $W > X > Y > Z$ is called a utility function. It tells us nothing about *why* we prefer X to Y. The utility function is a mapping that assigns a number referred to as utility to each of the options in such a way that one option gets a higher number than another if and only if it is preferred.

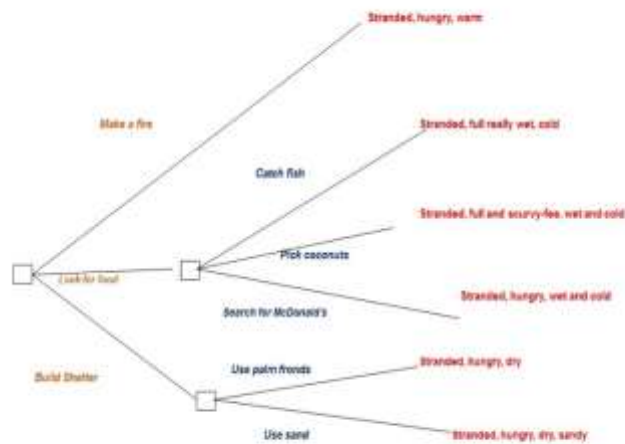
The conventional economic model, in the desert island case, also takes as a given the endowments of capital and labor, (natural capital): Abundant fish supply and the ability to fish, fire, and extensive coconut trees with ample fronds, etc. Recently, we have come to understand how human capital, know-how, tacit knowledge, and social networks confer considerable value beyond the immediately present quantity of natural capital. In the real world (at least, as noted earlier, this real world, rather than the planet Vulcan) economic decisions are not carried out by isolated, utility-maximizing individuals, but within networks of social relations that facilitate trust and cooperation, define actors' preferences, and, eventually, impact economic decisions and outcomes.

Back to choosing what to do your first day stranded on a deserted island: food, fire, or shelter. There are no tools readily available, you have only your hands to work with. Obviously, you cannot do all of three things simultaneously. What are you going to choose?

The answer is straightforward once you adopt a decision rule and a behavioral assumption. The behavioral assumption: people are rational; the decision-rule: you maximize your utility- you look out for number one.

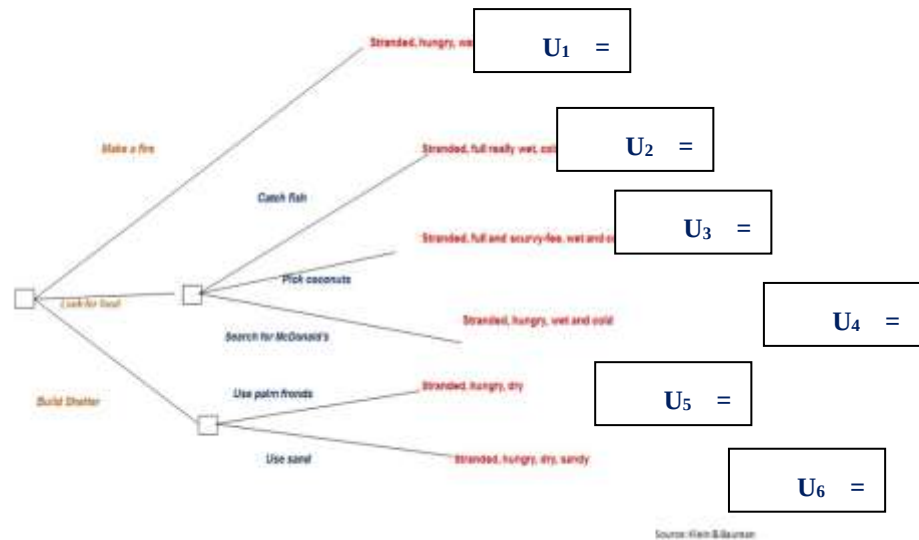
What have we done? Joined means and ends – by relying on rationality. Again, recall that given choices, a rational individual can rank them based on the utility provided by each of the alternatives. And once they are ranked, here comes the decision rule: pick the one that provides the highest utility.

This decision is graphically displayed in a “decision-tree” below.



Source: Klein & Laumann

The decision-tree is missing a very important feature. Each of the six outcomes above gives you some satisfaction; some utility. And once the utility is associated with each outcome, the decision is a done deal. And once these are attached to the outcomes we can predict the decision.



And that is it. The model predicts that you will choose to catch fish. An important takeaway is to recognize that there are no solutions, only tradeoffs – and invites the associated concept of an opportunity cost. Choosing to fish means that you opted to not build a shelter. The opportunity cost of your decision was the cost of not building a shelter.

Let's take a closer look. The possibility of realizing most of the outcomes present is inherently limited. Methodologically, we proceeded in steps. Clearly, there are costs attached to the three alternatives. Once the costs are netted out we now have *net* utility: the residual of benefits, *sans* costs. Still, we can rank net utility and again predict choice.

Another important takeaway is to recognize that individuals respond to incentives (or, as the case might be, disincentives). Suppose the cost of fishing changes: a storm surge has roiled the waters and it's impossible to cast a fishing line. The increased cost alters the net utility calculus and has an impact on decision-making.

The model we have constructed – albeit sound, is limited. It applies to a fraction of what we confront out there in the real world. Hayek says it eloquently. In *The Use of Knowledge in Society*, a paper published in 1948, Hayek took aim at the then fashionable practice of central planning. Yet, his criticism also indirectly assailed the orthodoxy in ways that revealed themselves later: that the conventional economic model is limited in its scope and reach.

The Use of Knowledge in Society

F.A. Hayek

What is the problem we wish to solve when we try to construct a rational economic order? On certain familiar assumptions the answer is simple enough. If we possess all the relevant information, if we can start out from a given system of preferences, and if we command complete knowledge of available means, the problem which remains is purely one of logic. That is, the answer to the question of what is the best use of the available means is implicit in our assumptions. The conditions which the solution of this optimum problem must satisfy have been fully worked out and can be stated best in mathematical form: put at their briefest, they are that the marginal rates of substitution between any two commodities or factors must be the same in all their different uses.

This, however, is emphatically not the economic problem which society faces. And the economic calculus which we have developed to solve this logical problem, though an important step toward the solution of the economic problem of society, does not yet provide an answer to it. The reason for this is that the "data" from which the economic calculus starts are never for the whole society "given" to a single mind which could work out the implications and can never be so given.

The peculiar character of the problem of a rational economic order is determined precisely by the fact that the knowledge of the circumstances of which we must make use never exists in concentrated or integrated form but solely as the dispersed bits of incomplete and frequently contradictory knowledge which all the separate individuals possess. The economic problem of society is thus not merely a problem of how to allocate "given" resources—if "given" is taken to mean given to a single mind which deliberately solves the problem set by these "data." It is rather a problem of how to secure the best use of resources known to any of the members of society, for ends whose relative importance only these individuals know. Or, to put it briefly, it is a problem of the utilization of knowledge which is not given to anyone in its totality.

Hayek's argument is that allocating scarce resources requires knowledge dispersed among many people. And no individual or group of experts capable of acquiring it all. Sound and informed decision-making entails allowing people to act on the information of "time and place" that only they have. In so doing they have established a system of information aggregation that motivates us and informs us on how best to respond to changing information.

Markets derived from exchange generate the information and motivation – and importantly, social context. This is far from the stylized model above and from the conventional freshman economics model: the market works properly only if all participants have perfect knowledge.

This is nonsense, as Hayek explains. If everyone had perfect knowledge, the case for the market would largely disappear. The market is essential precisely because it allows people to benefit from widely dispersed knowledge when no one has more than the smallest fragment of that knowledge, let alone government planners.

There are several points to be made here. Hayek is by no means the only critic of orthodox economics. There are many, including, as

we will see later – Herbert Simon, Daniel Kahneman & Amos Tversky, & Gerd Gigerenzer. We will examine their work in turn.

Yet, despite wholesale criticism and evident limitations, we still have to wonder why mainstream economics retains its pre-eminence among behavioral theories.

Many of the theorists in the second half of the 20th century worked to strengthen the mathematical rigor of economics, aiming to resemble the soundness and predictive capabilities of theoretical physics. The theory that emerged carried immediate and lasting appeal because it revealed a powerful hidden unity that explained much surface diversity. The theory that emerged was remarkably simple. It explained and predicted any number of things that were not in the theory itself (otherwise it would simply represent a tautology). The predictions advanced were testable and, importantly, falsifiable. This rendered it consistent with Positivism, the then-reigning methodological paradigm, that ensured the soundness of scientific beliefs.

And, as in all instances of theorizing, simplicity must be balanced against comprehensiveness. Limits to the theory were anticipated *because* of its simplicity and economy – as must be the case with all theories. Assumptions must be made to build the constituent elements of the theory.

And last, as we shall see, economics has been capable of absorbing much of the learning provided by its critics. Thus, despite the contrary evidence that has assailed (and undermined) it, mainstream economics remains strongly affixed to its preeminent role because of its resilience and because nothing sufficiently cohesive has emerged to replace it.

Afterword

Thaler, Richard H., Behavioral Economics: Past, Present and Future (May 27, 2016). Available at SSRN:
<https://ssrn.com/abstract=2790606>

Christian Arnsperge and Yanis Varoufakis, "What is Neoclassical Economics," *Post-Autistic Economics Review*, No. 38 (2006).

Sam Bowles, "Endogenous Preferences, the Cultural Consequences of Markets and Other Institutions," *Journal of Economic Literature* Vol. XXVI (March 1998) pp:75-111.

Appendix: Puzzle Mania

Answer the following questions.

Question 1

A bat and ball cost \$1.10. The bat costs one dollar more than the ball. How much does the ball cost?

Question 2

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?

Question 3

If it takes 5 machines 5 minutes to make 5 widgets, how long would it take 100 machines to make 100 widgets?

Explanations

These disarmingly simple questions – Shane Frederick’s cognitive reflection test - have profoundly affected the way we think about economics. Whereas economists, political scientists, philosophers, practically everybody – have assumed that human beings are rational, Daniel Kahneman, Amos Tversky, Gerd Gigerenzer and others have demonstrated that we’re not as rational as we like to believe.

Answer 1

The intuitive answer which comes to everyone's mind is 10 cents. This is not correct. The correct answer is 5 cents for the ball and \$1.05 for the bat. [$0.05 + (1.00 + .05) = 1.10$]

The quick response reflects (possibly) overconfidence, with a predisposition to placing too much faith in their gut-feeling, their intuitions. Why do we resort to an intuitive answer? For two inter-related reasons. First, the cognitive effort required to mentally search for the correct answers is mildly unpleasant – and thus to be avoided. And second, searching for the correct answer consumes energy, calories, and we are evolutionarily inclined to conserve as much energy as possible. Relegating to a heuristic what would otherwise be a tasking, cognitive effort.

Answer 2

Your first response is to take a (mental) shortcut (we all do). You tend to divide the final answer by half. That leads to twenty-four days. But that's wrong. The correct solution is forty-seven days.

Answer 3

An intuitive response would be that “ $5=5=5$ so $100=100=100$ “. However, if it takes a single machine 5 minutes to make a single widget, even a million machines can make a million widgets in 5 minutes. The correct answer is therefore 5 minutes.

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LECTURE V: CONSTRAINTS AND LIMITS ON DECISION-MAKING

An economist by training thinks of himself as the guardian of rationality, the ascriber of rationality to others, and the prescriber of rationality to the social world.

*Kenneth Arrow
The Limits of Organization (1974), at 16.*

We make hundreds of decisions every day, from the mundane to the momentous: What cereal to purchase, boxers or briefs, a field in which to major, a particular job we should take, a new car we should buy, whether to marry, or demand a divorce. The manner in which we make decisions typically works for us.

Until it doesn't.

Consider the following examples. A medical pandemic is afflicting the United States. So far, 600 people are afflicted. You are the CDC guru. You are asked to choose between two medical treatments for people affected with a medical disease: A & B. You can only choose one. Here are two scenarios that differ in the manner in which they present, or "frame" the decision.

Scenario I. Treatment A saves 200 lives; with treatment B, there is a 1/3 chance of saving 600 people and a 2/3 chance of saving no one. Would you choose A or B?

Scenario II. Treatment A leads to the death of 400 people whereas treatment B provides a 1/3 chance that no one will die and a 2/3 chance that 600 will die. Would you choose A or B?

Here is another example; it speaks to our understanding of what motivates people to give of themselves. Classical economists would have no qualms recommending that blood banks pay for blood. Adequate blood supplies are a perennial problem for blood banks.

But consider: which is likely to result in more blood being given? A: Paying for blood; or, B: Exhorting, pleading, persuading, and cajoling people to “do the right thing.”

Here is a third one, documented in a paper by [Gneezy and Rustichini](#). Classical economists understand the power of incentives, and disincentives. When parents continued to arrive late to pick up their children at a day care center, the administrators decided to impose a fine. The fine would apply to any parent arriving past the pick-up hour. Do you think that the fines reduced the parent’s tardiness?

Finally, if we are to compete, it is by far better to be the winner. But what about after that? Is it better to be second or third? Who do you think would be happier? Medal ceremonies provide great examples of this phenomenon. Sport’s medal ceremonies are fan-favorites; we share goodwill and extend public recognition and our appreciation to the deserving athletes because we know that for them, it reflects years of sacrifice and devotion to their calling.

There is no ambiguity in zero-sum games: For someone to win, the other participants have to lose. And we rank the outcomes. The silver medal is awarded to the person who arrives second, followed by the bronze for the third placer. The gold medal, to the winner. The conventional economist might think that the “happiness” felt by the medal winners would resemble the medal order. Is the happiness ranking consistent with the medal order?

The point of the examples is to contrast our answers, or what we think most people would answer, with the reasoning based on the rational model. The upshot is that it is not that difficult to demonstrate how we routinely make “decision-making mistakes” when we endeavor to make decisions or organize our thinking. But they are only “wrong” in the sense that they are contrary to the rational model. Once we understand the context, they make a lot of sense.

Consider the explanations and then appraise the analytical advantage of including the “context” in understanding the decision-making.

In the first example, the pandemic, the frame in which the analytical scenario is put forward matters. [Amos Tversky and Daniel Kahneman](#) noted how the particular frame affected decision-maker’s responses when presented with a choice in a hypothetical life and death situation. Most people chose A in the “positively” framed example. And B in the “negatively” framed one.

How does this contradict the rationality hypothesis? Recall that the tool that is required here is the Expected Utility Model. And the prediction of the EUM is that the choice remains constant over the two scenarios proposed. Put differently, the frame should not matter in the decision-making.

Expected utility is the utility (or the value) of the outcome multiplied times the probability of that outcome occurring. Formally, the Expected Value of both choices in the hypothetical is equivalent: $[(1/3)*600 + (2/3)*(0)] = 200$ and $[(1/3)*(0) + (2/3)*600] = 400$. Thus, the proper response within the classical, rationality models is that in both instances we should be *indifferent* to the choice of treatment.

Second, the blood bank comes up against the “hard core” conventionality in economics to state that “more is better.” And, if you will, that money is what it’s all about! Here we have to consider the incentive operating: Is it a monetary incentive? The prediction of the rational model is that the utility of the payment for donating blood increases with the money offered and therefore more people react by donating more blood. As it turns out, in the real world, this expected increase doesn’t happen. In instances where this monetary incentive has been provided for giving blood, donations were seen to drop dramatically. The presence of money is called “reward undermining” and generally falls under the broader question of “[motivation crowding](#).” This occurs when an external incentive disrupts our internal motivation for some behavior – like paying people to give

blood. Contrary to many real-world situations, money can actually serve as a disincentive for behavior.

The day-care center beset by late-arriving parents violated a well-established social norm – do not impose unduly on the goodwill of the daycare center staff – is the third example. The sense of guilt and embarrassment that would accompany late-arriving parents in combination with the off-putting frowns, body-language that expresses displeasure and the ill-will late arrival would engender among the staff would work against late arrivals. When a parent is late, they are truly chagrined and apologetic. The monetary fine eliminates any consideration we may have about others person's time or feelings.

The fourth example, the medalist's paradox, piqued the interest of [Victoria Medvec, Scott Madey and Thomas Gilovich](#), who explain the peculiarity in terms of what they call counterfactual thinking. Olympic bronze medalists appear happier than silver medalists because they are appraising the outcome from different reference points. The bronze medalist is ecstatically happy he won something. The silver medalist is probably quietly chastising herself for not doing well enough to have gotten the gold. Medvec and her colleagues show that this is indeed the case. The rationality model would predict that the silver medalist would be happier.

The *simulation heuristic* is a cognitive heuristic, whereby people determine the likelihood of an event based on how easy it is to recall or picture the event mentally. People experience more regret over outcomes that are easier to imagine, such as "near misses."

The simulation heuristic was the work of Tversky and Kahneman as a specialized adaptation or derivation of the availability heuristic. They proposed the simulation heuristic to explain counterfactual thinking and regret.

The simulation heuristic it is not the same as the availability heuristic; rather it is a special case. Specifically, the simulation heuristic is defined as "how perceivers tend to substitute normal antecedent events for exceptional ones in psychologically 'undoing'

this specific outcome." The subjective probability judgments of an event, used in the simulation heuristic do not follow the availability heuristic. These judgments are not the cause of relevant examples in memory. Instead, they are based on the ease with which situations that did not happen can be mentally simulated or imagined. We rely on the simulation heuristic to understand and predict the behavior of others in certain circumstances as well as to derive answers to questions involving counterfactual propositions.

The process is as follows. We mentally “undo” the event and then run mental repeated simulations of the events with the corresponding input values of the altered model. For example, in their 1981 paper Tversky and Kahneman provided a group of participants with a situation describing two men who were delayed by half an hour in a traffic jam on the way to the airport. Both men were delayed and they both missed flights on which they were booked. One of them missed the flight by half an hour and the other man by only five minutes (because his flight had been delayed for 25 minutes). The results showed that a greater number of participants thought that the second man would be more upset than the first man.

To Kahneman and Tversky, this difference was distinct from disappointment, because both men had expected to miss their flights. The true explanation was that the group participants utilized the simulation heuristic. They could imagine variations in each individual’s simulated ride that would have enabled the men to arrive in time. But it was much easier to do so for one than for the other.

Our judgments are inevitably biased towards information that we can visualize; that is to say, easily imagined or simulated mentally. It is because of this ability to see how things could have been that we tend to overestimate how causally plausible an event could be. And similarly when outcomes are negative or unpleasant – such as an accident we cannot avoid the enhanced regret experienced because we can so easily construe the steps we could have taken to avoid the negative outcome.

In another Kahneman and Tversky study, two individuals were given lottery tickets and then were given the opportunity to sell those same tickets back. The tickets could be sold back two weeks before the drawing or an hour before the drawing. The responses of participants in these studies showed that they believed that the man who had sold his ticket an hour before the drawing would experience the greatest anticipatory regret when that ticket won.

Again, "people's anticipatory regret, along with reluctance to sell the ticket, should increase with their ease of imagining themselves still owning the winning ticket". Therefore, the man who recently sold his ticket will experience more regret because the "counterfactual world", in which he is the winner, is perceived as closer for him than the man who sold his ticket two weeks ago. This example shows the bias in this type of thinking because both men had the same probability of winning if they had not sold their tickets and the time differences in which they did will not increase or decrease these chances.

Constraints & Limitations on the Model of Decision Making

The first limitation follows from recognizing that Robinson Crusoe's existence is enriched with the arrival of Friday. The arrival of Friday to constitute this little society stands as a representation that most outcomes of interest to us entail the participation of another or multiple parties. More on this in the next chapter.

Anticipating greater detail later we can draw some generalities. They are many: (a) individuals are different, they have different talents; and, (b) an individual's performance – and returns – improve with specialization; (c) outcomes depend on the combined actions of individuals; (d) much of the interaction – and the institutions we create – are designed to facilitate trade; in other words, the essence of successful trade is collaboration.

A second decision-making limitation involves our cognitive abilities; there are limits on our intellectual capabilities. We are not omniscient: we cannot know everything, remember everything, compute everything. We don't process information in absolute terms, for example, but in relative terms, by comparison to a point of reference.

The brain is designed to establish and use these reference points – as part of the decision-simplification process. And using reference points does help in many circumstances. But if we adopt the wrong reference point, we lose perspective on what really matters.

A second type of limitation is that we don't have unlimited time to make decisions. Think back to our example of driving on the Merritt Parkway. Or better yet, dial back to yesteryear – to our time in the savannah. You hear rustling, see a flash through the corner of your eye, or some whistling in the back of the tree-line. You immediately run for safety. Each of us exists because one of our ancestors won the Darwin lottery. They made decisions rapidly and, seemingly, without thinking. They had to: Avoid a predator, defuse a violent situation, react to a deer in the headlights in front of their speeding car. Real-world decision-makers don't have the luxury of waiting: Waiting until all the information is collected and calmly processing costs and benefits would today be viewed (negatively) as evidence of mere procrastination, lack of decisiveness, or insufficient backbone. For our *Australopithecus* ancestors, it would have been life-threatening.

Time is a critical constraint that influences our decision-making. When deciding on a big-ticket item, for example, time is both friend and enemy. Shopping, acting slowly and deliberately, may give you more time to obtain information. But, gathering information can, itself, cost time, effort, and money. And, acting slowly also carries opportunity costs: You can lose the opportunity to faster-moving actors or meekly observe a rise in interest rates.

These limitations – cognitive abilities and time constraints – alongside strategic uncertainty and Hayek's injunctions, prevent

simple, foolish humans from being the ideal decision rational decision-makers in the mold of *homo economicus* – the lynchpin of the REM. We cannot make optimal decisions that always lead to the best outcome, even if we wanted to.

Recognizing these limitations was the great insight of Herbert Simon, who gave us the notion of bounded rationality or “rationality within limits.” Simon contended that the key challenges for real-world decision-making consist of acquiring the right information, simplifying the decision process, and adopting strategies for decision-making. In short, it’s not about optimizing, but rather, about *satisficing*. Overcoming cognitive limitations cannot necessarily be a function gathering more information, being more deliberate, or deploying more refined and complex tools of analysis.

We adopt rules that allow us to prioritize information and examine the particular context or environment, all in an attempt to simplify complex decisions into something manageable: To derive strategies – models – that can be implemented quickly and with little effort.

Why Model?

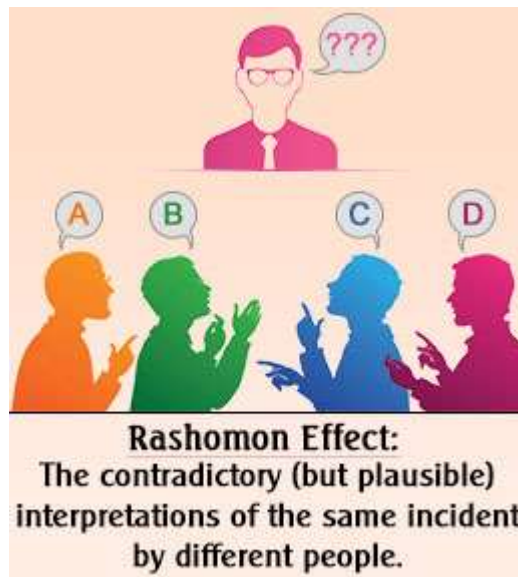
John Pollack has written an excellent book that has by and large failed to generate the buzz that it deserves. In *ShortCut*, Pollack writes about analogies and how pervasive they are in our everyday undertakings. Analogies represent fundamental constructs that we rely on to transmit and communicate ideas and information. We, as humans, are not only predisposed to use analogies – we are acutely sensitive to them.

Analogies, therefore, are useful. But by their very nature they are limited. In proffering an analogy we have to strip some of the elements of the tale, story, narrative, or idea we are communicating and single out others. This, necessarily, can offer – at times – a distorted view. Something like Rashomon or the tale of the elephant

and the seven blind men. We rely on them to economize on information and to make sense of things.



Recall Chauncey Gardner, Peter Seller's character in the movie *Being There*. In a particular scene Chauncey – who by this point in the movie has risen to the level of economic sage, all by happenstance since Gardiner was a little slow-witted and a gardener by trade – is asked by an aspiring presidential candidate about the economy and the stock market. Chauncey replies, “It needs tending,” and “There will be growth in the Spring.”



“The *Rashomon* Effect”

- The four narrators in *Rashomon*—striking poses to match their characters—tell five radically different versions of the same story.
- The fact that witnesses often give contradictory accounts comes to be called “The Rashomon Effect”



The image imputes a certain docility to the market, a serenity that can be reached by careful husbanding. On the other hand, referring

to the market as a war zone, or a jungle, the viciously competitive zero-sum narrative of sports, or describing it as rigged elicits an entirely different perspective – and, frequently, policy response.

Economic models are examples of analogies – set forth even more succinctly. The go-to model in mainstream economics is called the Rational Economic Model (REM), sometimes referred to as Rational Choice, or, simply, the Rational mode. It has proven hugely powerful...yet chockful of shortcomings.

For all its success, the rational model has come under fire. It is well known that in some situations, individuals make decisions that are contrary to the elementary assumptions described earlier. Discussed below are two bedrock assumptions of the REM – “incentives matter” and “more is always better” – violations of which, by actual, human behavior, have frequently been observed and documented. The implications of these observed, *behavioral* deviations from the REM have had earth-shattering implications for our understanding of both economics and psychology...not to mention their impact on public policy.

Incentives don’t always work in the manner we think they should. As we saw in the introduction, monetary incentives will simply backfire, in some situations. Rather than encouraging and fostering a desired activity, they tend to discourage the individual from taking the intended action. Recall the initial example on the matter of enhancing blood bank supplies: When an “incentive” was offered for blood, said incentive simply didn’t work. In fact, it decreased donations. Most people who donate blood do so for altruistic purposes – and payment seemingly corrupts their motives and undermines their psychic reward; and thus, they choose to not give.

Takeaway

Much of the original and, literally, prize-winning work in Behavioral Economics research, took aim at the REM. Not surprisingly, this research found the REM lacking. Behavioral

economists then concluded that real-world firms and individuals were lacking in the ability to make proper decisions *because* they failed to conform to the rationality-based prescriptions. And they responded by advancing policy prescriptions that would remedy the diagnosed shortcomings. Ironically, this last conceit is also a mistake, for it assumes that individuals and markets are perfectible.

Inferring more from the REM than what is there, an instance of reification, is a mistake. The REM is a model, a representation. To draw inferences beyond its capabilities is a fundamental mistake, an abuse with a long presence in economics. In competition policy, for instance, markets in which prices are greater than marginal cost were “suspect,” and would trigger the entire antitrust enforcement apparatus into action.

Overplaying the lessons from the model has elicited criticism. One of the better known is Howard Demsetz’s *Nirvana Fallacy*.⁶ The Nirvana Fallacy contains three elements. First, we ignore the costs of corrective economic policy interventions by government but account for costs on consumers and on the economy. Second, the model is driven by efficiency considerations and disregards the true tastes and preferences of consumers in economies who possibly rank, given the disparity in wealth, equity considerations higher than they do economic efficiency considerations (getting prices right). Third, analysts often assume that markets are perfectible. This perfection is unattainable. Markets are what they are in response to any number of institutional, normative, and historical considerations.

⁶ Harold Demsetz, Information and Efficiency: Another Viewpoint, 12 JOURNAL OF LAW AND ECONOMICS 1, 1 (1969).

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LECTURE VI: STRATEGIC BEHAVIOR

“Two or more individuals have choices to make, preferences regarding the outcomes, and some knowledge of the choices available to each other and of each other’s preferences. The outcome depends on the choices that both of them make ... There is no independently ‘best’ choice that one can make; it depends on what the others do.”

Tom Schelling

So far, our world was Robinson Crusoe without Friday – a life of isolation where all decisions are simple. Do I farm, or do I fish? Do I eat coconuts or berries? Do I plant one type of potatoes or another? Do I sit around and rest?

Crusoe’s world was about decisions against nature. In our Type II analysis, the “state of the world” is revealed *after* we make our decision. And given that we know the outcome and the value of the outcome, we can work backwards to choose the best path to the preferred outcome. It’s easy to connect-the-dots after the fact.

For example, whether I go to the other side of the island on the off-chance that the fishing there is better cannot be answered unless I know the possible outcome and how much that specific outcome is worth to me. Note that the same reasoning (model) travels well. It requires the same answers if you are considering moving from stocks to bonds or whether you major in communications; or whether you launch the new product in your company. Frankly, the model is quite useful despite its considerable information demands.

But realistically, many real-world decisions involve other parties. In fact, we can probably state, categorically, that most real-world decisions involve other parties. It follows that the outcomes of our decisions are intertwined with the actions of others and are often dependent on the interplay of our actions, the actions of others, and our multiple reactions. This interaction compels us to incorporate and consider the goals, plans, and anticipated actions of other people in determining what we should do. And, in the real world, the goals and plans of others may not be aligned with ours.

There are many, many examples of this interlinkage: Soccer penalty kicks, relationships, marketing decisions, emotionally-charged decisions such as to what to have for dinner with our significant other, and so on, and so forth. Thus, to the extent that we recognize this interconnectedness, the essence of the task – of all economic activity – boils down to determining how to coordinate.

Consider the following toy example: Suppose you are meeting at a restaurant with another party. You want to eat in West Haven, your friend wants to go to New Haven. The goals are not similar. You go back and forth without agreeing. She storms off: Her last words to you are, “My mobile phone has no charge left so I have to hang up. Meet you in New Haven.” Consider the general principle: She “won” by limiting her ability to make a decision. This same strategic action applies to individuals, groups, companies, and even nations.

Sometimes the action required to arrive at the “equilibrium” is not available. The story of how NHL Helmets came into use is a fascinating one – and conveys this insight easily. The analysis of the usage of hockey helmets was set forth in a paper by Thomas Schelling. The title of the paper alone is hugely informative: *“Hockey Helmets, Concealed Weapons, and Daylight Saving: A Study of Binary Choices with Externalities.”* It conveys not only the frame but the generality of the frame.

For the decades, hockey was played without helmets. There was a sense among players that using a helmet conveyed an image of powerlessness and invited abuse – verbal, psychological, and physical. Using helmets limited a player’s field of vision and, given the choice, no one would wear one because playing *sans* helmets would give one an edge. If everyone on the ice wears no helmet, there is no particular “range of vision” advantage. Likewise, if everyone does wear a helmet, again, there is no “range of vision” advantage. But, without helmets, the rate of injury is quite high. No player would willingly opt to be the first one to wear a helmet – he would be shamed *and* he would have to compete at a range of vision

disadvantage. As a result, the less preferred outcome (more injuries) was the equilibrium – the one that prevailed.

It took the league to compel the usage of helmets by passing and enforcing rules requiring players to start using them. And therein two general principles. First, often the state (in this case the league) may be the least cost mechanism to overcome the impasse that results from our inability to coordinate. Note that the league, composed of owners, collectively had an incentive to minimize injuries. All this stands as a key insight into our policy discussion, later in the semester: The considerable effort and monies that currently go into rent-seeking and preferential treatment may be the realization by interest groups that it's the state that can forcefully overcome the recalcitrance of others.

Second, in the helmet-less world, the norm, the custom, that prevailed was both straightforward and easily enforced by the players and the fans – mocking and shaming those who considered wearing a helmet. Norms and customs have considerable sway in our daily lives. Conceivably, rather than state intervention, a norm rendering helmets the preferred choice may have emerged over time. In fact, existing norms are understood to be resolutions to historical free-rider problems. Over time, an applicable norm may have emerged. But the public's concern and associated political pressure on professional hockey may have curtailed the disposable time available for a spontaneous emergence, or deliberate change in helmet practices.

Before we can focus on how to coordinate to determine the best actions to take, we have to establish a baseline. The baseline we propose recognizes the stark realization that the inability to coordinate when facing joint outcomes – that looking out for number one, being rational – often leads to the worst outcome possible. In the NHL helmet story, the inability to persuade others to wear helmets led to a situation characterized by high rates of injury. This baseline is encapsulated in the famous *Prisoners' Dilemma*.

The Prisoners' Dilemma

There are two potential choices for each player. In the simplest case, we assume each faces the same binary choice. Again, to belabor the point, the outcome depends not just on each player's individual choice but also on the choice of the other player.

The relative payoffs of the outcomes are represented by cardinal numbers. The larger numbers typically (and arbitrarily) indicate better outcomes, that is to say, preferred outcomes are assigned a higher number.⁷

The modeling exercise requires an assumption about how people should behave. We opt for our go-to assumption: rationality. Here are the rules of the game:

- Players are rational;
- Players prefer more to less.
- Players assume that other players are also rational;
- Players assume that other players are similarly motivated by their own outcomes;
- Players cannot communicate during the game;
- Players cannot collude to split the payoffs after the game;

- The decision rule is a simple one: We choose the alternative that provides the greatest payoff.

The associated context is simple: You and your lifelong friend were captured red-handed committing a burglary. You were both brought to the police precinct to be separately interrogated. Each of you was separately offered, by the prosecutor, a choice between cooperating with the prosecution – ratting on your dear, best friend and partner in crime – or staying silent, refusing to cooperate.

⁷ Interestingly, and often a source of confusion, in the prisoners' dilemma the utility of the outcomes is reversed; that is to say, we prefer *less* years in jail to more..

Attached to each choice is either a jail term, or the possibility of walking. To repeat, the prosecutor offers you the following deal: If you cooperate (and fink on your buddy), you walk free. If you don't cooperate, then you go away for one year. But there's a catch. The prosecutor lays out her terms: If your dear friend does cooperate – if SHE rats YOU out – but you don't and chose to stay mum, then the one-year lockup is off the table. Instead, you get to go away for three years. But, if you BOTH fink on the other, then you both go to jail for two years.

The simple situation is represented below in the archetypal example in the modeling of strategic behavior: The Prisoner's Dilemma in a decision matrix format.

		Prisoner 2	
		Hold my tongue	Fink
Prisoner 1	Hold my tongue	(-1,-1)	(-3,0)
	Fink	(0,-3)	(-2,-2)

The rows reflect the choices available to prisoner (player) 1 and the columns reflect the choices available to prisoner (player) 2. Prisoner 1 chooses whether to Cooperate (Fink) or Not. Prisoner 2 is also offered the same deal and is similarly asked to choose. The number within the parenthesis are the payoffs to each player. The number on the left is the payoff to prisoner 1 and the one on the right is the payoff to prisoner 2. There are four possible outcomes given

the choices each prisoner can make. Thus, if Prisoner 1 chooses to confess (Fink) and prisoner 2 chooses not to confess, then from the numbers in the parenthesis in the lower-left hand column (where the row choice intersects the column choice) Prisoner 1 gets 0 years in jail and Prisoner 2 gets 3.

The first thing to notice is that the northeast and southwest quadrants make it clear that BOTH prisoners have a strong incentive to Fink: Zero years in prison is most certainly superior to one, two, or three years. The only way you have a chance at zero years in prison is to rat out your lifelong friend.

But, recall that for Prisoner 1 to determine her best option, she has to get “into the head” of her partner-in-crime. Prisoner 1 (you) decides to choose by breaking the problem up into two parts, engaging in visualizing the following scenario. “What do I do if my dear, loving, best friend forever rats me out? This means I get two years in jail (-2) if I rat her out and three years in jail if I do not (-3).” Two is better than three – recall the decision rule: you choose to be a rat.

On the other hand, if your friend decides to stay mum, you walk if you talk, and you go away for one year if you don’t. So, you decide to talk (walking is preferable to one year in jail). As it turns out, after finishing your introspection, you realize that under both scenarios you are better off talking, confessing, telling. And the same goes for your friend, whom you have realized you no longer trust with your life.

In the jargon of Game Theory and Decision Theory, since ratting out on your best friend always results in a better payoff, regardless of what said best friend does, “ratting out” is referred to as the *dominant strategy*.

The decision examples – the Prisoners’ Dilemma and the NHL helmet story – the outcome represents what’s known as a *Nash equilibrium*. It is an equilibrium because neither player has an incentive to change his / her choice unilaterally. It is an equilibrium point, but not necessarily an optimal outcome. The ideal outcome would be where both players stay mum and either walk or serve a

single year. The astonishing thing here is that by taking the best action before you, the pair of you end up in the worst possible outcome.

And the question before us is: How general is this game? After all, it implies that the world as the prisoners see it, and what we will all see is a world described as solitary, poor, nasty, brutish, and short. But it is worth reviewing the Hobbes quote in its entirety because, somewhat ironically, it reflects the fruits of cooperation as a casualty of the compelling logic of the Prisoners' Dilemma.

No arts; no letters; no society; and which is worst of all, continual fear and danger of a violent death; and the life of man, solitary, poor, nasty, brutish, and short.

As it turns out, fortunately, this Hobbesian state of nature – in which we are all at war against all – is the exception rather than the rule. It appears we humans have learned to cooperate – it's in our genes.

The Prisoners' Dilemma served to explore a key feature of the relationship between Crusoe and Friday. And perhaps more importantly, cooperation among all colonists, once the colony grows, – that is to say, when others join Crusoe and Friday. When the two-person prisoners' dilemma is "generalized" to many players, a group, a society, a nation, a group of nations, the problem is known as a social dilemma or an "n-person prisoners' dilemma."

In the n-person game, outcomes still depend on the decisions of many individuals. And the desired outcome is not necessarily the equilibrium outcome. And this frame applies across countless modern conundrums: climate change, treaties, threatened species, political problems, among many. The fact remains that escaping the compelling logic of the Prisoners' Dilemma is an ongoing and preeminent problem of our times – not only in economics, but of society. Resolving the numerous social dilemmas will engage us for many, many years to come. From where does our propensity to cooperate arise?

The Iterated Prisoners' Dilemma and the Evolution of Cooperation

In a prisoners' dilemma, a player will always get more by defecting (or finking). But this structure of incentives changes and the associated strategy available to players changes if the "game" is repeated indefinitely. With multiple games, there is the opportunity for a player's action to have consequences; thus, an action can be reciprocated, or punished. And anticipating consequences to individual actions has an influence on each players' actions. The upshot of this insight is that the prospect of punishment of defectors ensures cooperation among rational individuals. There is no need to "enhance" individuals' utility functions to accommodate "cooperation" as an attribute.

Formally, the repeated game results in a Nash Equilibrium that is distinct from the one-shot Prisoners' Dilemma Nash Equilibrium. And it is the *Folk Theorem* that demonstrates this emergence of social cooperation. The Folk Theorem is so called because it has no specific provenance. It is part of the "folk-lore" of game theory.

Given the possibility of repeated interactions, there are multiple approaches to dealing with others open to every player – ranging from always cooperating to never-cooperating to every possible combination in between. Those who are likely to prevail in the long-run are those who play "tit-for-tat." This entails cooperating when your counter-party cooperates and defecting (refuse to cooperate) when your counter-party does not cooperate.

This trait clearly increases the survival chances of a species. Thus, humans have a built-in tendency to cooperate and, equally, a predisposition to refuse cooperation if we feel others are taking advantage of or exploiting us. This gives way to recognizing the evolutionary nature of reciprocity.

Indirect Reciprocity and the Power of Reputation

The exhortations to pay kindness with kindness – paying it sideways or forwards – are commonplace. Kindness begets kindness. ‘Tis a virtue much admired.

In small groups, back when humans were confined to the savannah, indirect reciprocity – more simply, being kind – conferred advantages to an individual. It served a useful, life-preserving function. *I’ll help you today if you help me tomorrow*. This “two-way” cooperation had so many clear advantages for both of us that over time it behooved the individuals to value this trait in others. In turn, it became embedded within norms and culture of groups – clans, tribes, villages, etc. Recall that norms and practices embody the group’s communal knowledge and represent a low-cost way of transmitting this know-how onto subsequent generations. In this instance, this know-how is known to us as direct reciprocity. To understand direct reciprocity, we need to look at repeated games.

Direct reciprocity engages us both you and me. But in reality, when dealing with you or any other person in the group, I take into account more than just our interactions. I also take into account the experience of other members of the group. This is known as indirect reciprocity and its advantages derive from the power of reputation.

As groups got bigger, direct interaction was not always possible or even desirable. Increases in trading and transactions and, therefore, our wellbeing, had to depend on indirect reciprocity to expand and thrive. Thus, we became predisposed to obtain information. In those times, this meant conversing with others – what today may be known as gossip, chat, or banter. By paying attention to gossip, seeking conversation, chatting up people – even, or especially, strangers – and engaging in banter, I am able to gauge the reputation of strangers...and potential trading partners. I am able to size them up,

assess and appraise them as part of the process of deciding how to deal with them. As a result, I can now benefit from the experience of others and not limit myself to trading and interacting only with known individuals.

Now my decision to trade with you not only depends on the nature of our interactions, but also on how you have interacted with others. Thus, knowing someone's good reputation, by keeping your ear to the ground, oils the wheels of commerce. And given the benefits of trade it is not surprising that a host of institutions whose sole purpose is to appraise, vet and communicate reputations spring up all around us. Thus, groups and populations manage to grow and benefit more than others depending on the quality of the institutions that emerged dedicated to ensuring the mechanisms of trade, especially reputation.

Importantly, one is wise to remember that cooperation means paying a cost for someone to receive a benefit. Reputations are purchased. A little generosity secures one a reputation, which may be worth a great deal more than the initial cost – in the long run. “Our actions have consequences that go far beyond any individual act of charity, or indeed any act of mean-spirited malice.”⁸ We all behave differently when we live in the shadow of the future.

Relatedly, note that for the concept of a reputation to prevail and replicate, we needed language. Thus, language naturally evolved. Consequently, Indirect Reciprocity played a central role in the development of language. Moreover, it has propelled the development of our brains, of our ability to lay down memories, and the near universality of our moral codes.

Note that there is a clear link between the relevance of reputation as a tool of trade and the evolution of empathy. We developed a “theory of mind.” Only humans have the ability to understand the desires, motivations, and intentions of others. This mind-reading ability allows us to infer another's perspective, whether emotional or intellectual. The preeminence and role of the function of indirect

⁸ (Nowak & Sigmund, 2005)

reciprocity promotes social intelligence: Observe others, learn about them, understand who did what to whom and why.

We are always processing the impressions left by others and are more likely to give to somebody who has a good reputation, someone who has in her or his past given help to others – not necessarily to me...just to *somebody*.

Now, let's look at our human-ness a little deeper. Consider an example in markets where value depends on what other people are thinking; a good example of this is the stock market. John Maynard Keynes had much wisdom when it came to picking stocks. In what has come to be known as the Keynesian *Beauty Contest*, he concluded that share price must result, not from the fundamental value of the company, but from the *average of what investors think that all the other investors think is the value (price)*. By this reckoning, the most successful investors are the ones that can appraise the general sentiment of most investors and stay one step ahead. To quote Keynes directly,

Successful investing is anticipating the anticipations of others.

He illustrated it with the following insight into the contest run in a London newspaper whereby readers were asked to vote on the most beautiful of a number of women whose photos were prominently displayed in the inner pages of the newspaper.

'It is not a case of choosing those [faces] which, to the best of one's judgment, are really the prettiest, nor even those which average opinion genuinely thinks the prettiest. We have reached the third degree where we devote our intelligences to anticipating what average opinion expects the average opinion to be. And there are some, I believe, who practise the fourth, fifth and higher degrees.'

(Keynes, *General Theory of Employment Interest and Money*, 1936).

Consider another example: Suppose that you and 9 other players must choose a number between 1 and 100. The winner is the one whose number is closest to two-thirds of the group's average. Recall that for you to figure out a joint outcome you have to get into the head of the other players. You figure out that if the average of the group is 50, then someone whose choice is nearest 33 would be the winner; so, you pick 33. But wait a minute! Other players are rational just like you – and they can figure out what you just did. They know that they should pick 33, so to outsmart you they will pick need to pick $\frac{2}{3}$ of that, or 22. So the competition decides to pick 22. But wait another minute! The others can follow that reasoning too – so they will pick 22. So, you need to pick $\frac{2}{3}$ of that, and so one. The take away: Everyone should pick the number 1, but hardly anyone does.

We do not have the computational ability to reason through all the steps of such a complex decision problem: we are *boundedly rational*. But we don't approach the problem in a mathematically optimal way. Instead, we approach problems in a way that's suited to our own computational limitation, and then we try to take advantage of the structure of the world around us. Context matters.

The key idea in all these examples is that optimal choices in real-world games depend on our assessments of the rationality of other players – an aspect of context.

Importantly, you can use your own limitations as a guide to the limitations of others. This can be illustrated by an archetypal game called the *Stag Hunt*. It alludes to the idea that by collaborating with others in my tribe or clan, together we can snag a stag. Not collaborating relegates us to catching a mere hare. A hare we can snare by ourselves, independently, working as individual actors.

Before you choose, you must, again, step into the minds of others. You know others might be inclined to not hold up their end of the bargain, to cover the area that they are supposed to – even if they have agreed to do so. We all are aware that there is some risk that someone will shirk their responsibilities. This is so because they may shirk willingly or because of a simple mistake. Following this train of

thought, you start to doubt the success of the venture. Moreover, your own doubt might be a guide to what others are thinking and to the possibility that someone will shirk. Convinced by your own doubts, you refuse the collaborative effort and remain on your own, as do many of the others.

The unfortunate result is that the entire village has to figure out how to survive the winter without a nice, big, storage cavern full of venison. One way around this, from the standpoint of the village, is to impose sanctions or punishments on those who fail to cooperate. You will have greater faith in the cooperation of others if you know that punishments for the non-cooperation of others will be enforced. This, quite literally, represents the beginning of government...of the state.

One very powerful contextual tool is to look for a focal point. The classical example is attributed to Thomas Schelling, and the various students in his class on Game Theory. In the days before mobile phones existed, he asked several of them to meet him in New York City on a particular day. He did not reveal a time nor a place. Many actually arrived at noon in front of the clock in Grand Central Station. Where else would you choose to meet, given limited information? Grand Central Station proved to be a focal point for any number of students familiar with the City.

Any answer is possible. But, if you actually pause and think about it, some answers are more plausible than others. Schelling called these *focal points*. Focal points have special properties that distinguish them from other choices, and thus, they facilitate coordination even when people lack precise information. Focal points are extracted from context, from culture, norms, and other practices common to a group or even particular subgroups of people.

Emotions, However, Get in the Way

To understand the role of emotions in business decisions (and no, it is not “there shouldn’t be any”), consider the *Ultimatum Game*. You

are given \$20 and told that you must offer to share some portion of the \$20 with a counterpart. If she accepts the one-time offer, you split the \$20 according to your offer. If she does not accept, neither of you get any money.

You offer your counterpart a portion, say \$1. In the Ultimatum Game, the rules clearly state that if your counterpart accepts your offer, the money is thusly split: \$19 for you and \$1, as proposed, for her. But, if she refuses the offer, neither of you get any of the \$20. In the event she will quite likely storm away, consumed by anger – claiming unfairness and berating you for being selfish – depriving you, thereby, of keeping ANY money. Her \$1 loss is considerably smaller than your \$19. Responders generally reject the meager offers. On the other hand, you can anticipate this rejection and the associated putdowns by getting into your counterpart's mind; and doing so you realize that you are better off being a bit more equitable. You chose to give her \$6, which she is more likely to accept. Behavior in the ultimatum game is seemingly irrational – until you acknowledge the theory of mind – which allows you to walk in other's shoes, the usefulness of focal points, the gains from trade. Note that your counterpart has the power to influence you but only if she behaves "irrationally." Accepting the \$1 would have been rational – it is \$1 she would not otherwise have acquired.

Consider, now, the *Dictator Game*, in which your counterpart has no option – she MUST accept whatever you offer. You are given \$20 and, then, turn around and GIVE your counterpart a portion, say \$1. The difference between the Dictator Game and the Ultimatum Game is telling. In in a Dictator Game your counterpart doesn't turn down the money she has been given – she can't, even if it's only \$1. Therefore, the rational thing for you to do is keep a very large portion of the \$20. \$19.99, perhaps. Experiments have consistently revealed, however, that players give more than \$1. It appears that humans take fairness and potential future consequences – the effect, for instance, on their reputation – into account; we all want to be liked.

In conclusion, it is important to realize that limiting your ability to make choices can have benefits. Recall the restaurant – and how your counterparty successfully selected the venue for your dinner date. In the Ultimatum Game, responders given unfair offers want to retaliate – they are angry. They are willing to sacrifice monies if it teaches the proposer a lesson. And they cannot turn off the emotion, even if they wanted to. It is precisely the willingness to sacrifice potential earnings, to behave irrationally and against our own self-interest, which provides the credible threat to discourage unfair offers. Emotions act to limit our choices; but in doing so they give us power over others.

Additionally, we can cooperate even if we have limited information. By paying attention to context – specifically, to reliable and available focal points – you can successfully coordinate actions with others.

Third, the reliance on the state or on a set of rules is often needed to overcome the compelling logic of the Prisoners' Dilemma or the Stag Hunt. And institutions emerge to formalize these solutions. Examples like laws, rights, sanctions, and standards. Ironically, regulations are often criticized for circumscribing freedom of choice. there are situations where this is true, of course.

It is good to recall Chesterton's fence. A Chesterton fence is the principle – and as a metaphor it stands as a decision-making rule of thumb - that reforms should not be made until the reasoning behind the existing state of affairs is understood. Thus, careful probing may reveal that not all regulations are exploitative.

We end with a well-known game-theoretic story. Once there was a westerner who while visiting Asia, happened upon a galley with a bunch of Chinese rowers enduring continuous beatings from their foreman. The shocked and morally outraged westerner immediately decried the injustice and inhumaneness of the practice...until it was explained to him that the foreman had been elected by the rowers to discharge the job he was doing.

AC DC Meet the Ultimatum Game

Who was the best AC/DC frontman: Bon Scott or Brian Johnson? The question of who was the better vocalist will continue forever. We don't, and can't, settle this question here: *de gustibus non est disputandum*. But we can certainly influence the debate using tools from experimental economics and a simple bargaining game known as the Ultimatum game.⁹

In the Ultimatum Game – there are two players: a proposer and a responder. Proposers are allocated a sum of money. Proposers must choose an amount to extend an offer to the responder. The responder, upon learning of the offer, must accept or reject. If the responder accepts the offer – she keeps it; the proposer keeps the remainder. If the offer is rejected both participants get nothing. Rational individuals should offer, and accept, the smallest possible offer: a penny, perhaps; but certainly, a modest one. After all, a penny and any of the modest outcomes leaves both participants better off than they were before the game started.

Remarkably, most responders refuse modest offers (anything below 30%, on average). In fact, most proposers seem to be intuitively aware of this outcome ahead of time – and therefore offer anywhere between 20% and 50% of the wealth available from the get-go (on average).

In our game, we expect most people to fall within the ranges mentioned above – indicating that University of New Haven folks not only value their own wealth, but also the wealth of others and the fairness of the allocation. However, the conventional economics would view offering and accepting anything other than the smallest possible offer as inefficient. And here lies the test!

In our version of the experiment, the responder gets randomly assigned to listen to either Brian Johnson or Bon Scott before they accept or reject. In our Bon Scott treatment responders listen to “It’s

⁹ This draws from the fascinating paper by [Robert Oxoby](#) (Oxoby, 2009).

a Long Way to the Top” from the album *High Voltage*. And in our Brian Johnson treatment responders listen to “Shoot to Thrill,” from the album *Back in Black*.

At the end we will tally up the results and reveal the influence of each vocalists: and weigh in on the eternal debate: UNH Economics style.

The winner of the debate gets the \$.

Further Reading

Robin Dunbar, Grooming, Gossip, and the Evolution of Language (London: Faber and Faber, 1998).

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Martin A. Nowak and Karl Sigmund, Evolution of Indirect Reciprocity, *Nature* Vol. 43, No 27 (October 2005) pp: 1291-1298.

Tsebelis, George, "The Abuse of Probability in Political Analysis: The Robinson Crusoe Fallacy," *American Political Science Review*, Volume 83, No. 1, (March 1989) pp.77-91.

**LECTURE VII: THE FORECAST PREDICTS “A CHANCE OF RAIN.”
SHOULD I TAKE AN UMBRELLA WITH ME?”**

*I've done the calculations, and your chances of winning the lottery are
identical whether you play or not.
Fran Leibowitz*

In an earlier lecture we started out with a simple model to explain what Robinson Crusoe would do in the simple world in which he was the sole inhabitant of his desert island. Progressively, we enhanced the story, we enhanced the model and, ideally, enhanced the breadth of our analytical capabilities. When Friday showed up, he brought an additional element of realism, a recognition that many of the consequences of our choices are not solely a result of our actions: we are not alone.

And again, following Hayek, we must push on to acknowledge another strong limitation of the model. The original model assumes that we not only know the outcomes of our choices but that we know how much utility resulting outcomes convey to us.

In reality, we must recognize that the outcomes of most of the decisions we make are uncertain. And so, we add to the toolkit – this time to enable us to confront decision-making under uncertainty. The resulting apparatus is hugely powerful and impressive. Yet, as we will see, it still leaves a lot to be desired. It seems that when economists and decision-theorists built their theory of decision-making under uncertainty they took a page from the teaching of mathematics. It is often said that a first approach to solving a mathematical problem is to transform it into a problem you already know how to solve. And as we shall see, the model of decision-making under uncertainty stands on the shoulders of the conventional model.

Albeit for a heavily constrained set of conditions, the decision-making model under uncertainty does provide suitable answers. With

but a touch of introspection it should be apparent that we disdain its recommendations. And the pedagogical armature for studying decision-making compels us to understand the nature of uncertainty. In turn, this requires a review of probability theory.

Gambling can be a useful tool for the understanding of uncertainty – and more specifically, the foundations of probability. Consider the history of gambling. It was Cardano's obsession with gambling led him to formulate that if a gambler throws a six-sided die the probability of rolling a 5 is 1 in 6.

We can draw more general insights. Consider a standard six-sided die. There is an equal probability of rolling each of the numbers 1-6. Thus, for instance, there is only one way to roll snake eyes (a two). The odds of rolling a particular value are always one in six ($1/6$). When we have two dice, the odds are not as simple – but they are straightforward. For example, there are a lot of ways (three) to roll a seven ($1+6$, $2+5$, $3+4$).

Probability is thus defined as the number of desired outcomes divided by the number of possible outcomes. This definition can be applied to sets of outcomes as well. There are four distinct ways of getting a five when rolling two dice out of 36 possible combinations:

$$2 + 3 = 5$$

$$3 + 2 = 5$$

$$1 + 4 = 5$$

$$4 + 1 = 5$$

Let's count how many ways there are to get each value when rolling two dice, values 2 through 12:

Outcome	List of Combinations	Total
2	1+1	1
3	1+2, 2+1	2
4	1+3, 2+2, 3+1	3
5	1+4, 2+3, 3+2, 4+1	4
6	1+5, 2+4, 3+3, 4+2, 5+1	5
7	1+6, 2+5, 3+4, 4+3, 5+2, 6+1	6
8	2+6, 3+5, 4+4, 5+3, 6+2	5
9	3+6, 4+5, 5+4, 6+3	4
10	4+6, 5+5, 6+4	3
11	5+6, 6+5	2
12	6+6	<u>1</u>
		36

If we want to calculate the probability of rolling a five, for example, we need to divide the number of ways to get five (4 ways) by the total possible combinations of two dice (36 possible combinations): $4/36 = 11.11\%$.

How many total combinations are possible from rolling two dice? Since each die has 6 values, there are $6*6=36$ total combinations we could get. If you add up the numbers in the **total** column above, you'll get 36. So, we can calculate the probabilities of each outcome:

Outcome	Probability
2	$1/36 = 2.78\%$
3	$2/36 = 1/18 = 5.56\%$
4	$3/36 = 1/12 = 8.33\%$

5	$4/36 = 1/9 = 11.11\%$
6	$5/36 = 13.89\%$

This foundation enabled gamblers to formalize the analysis of the odds they were facing. So, if a casino paid 10 times your bet for rolling a 5 on two dice, then a gambler could expect to gain 10 units for every 9 units lost betting. Over the long run, a gambler could expect to make money with this bet.

By multiplying the amount that could be won by the probability of winning, the gambler could calculate what came to be called the expected value of a risky choice, or the expected value of a gamble, and a method for the analysis of risk. Generally,

Expected Value (EV) =

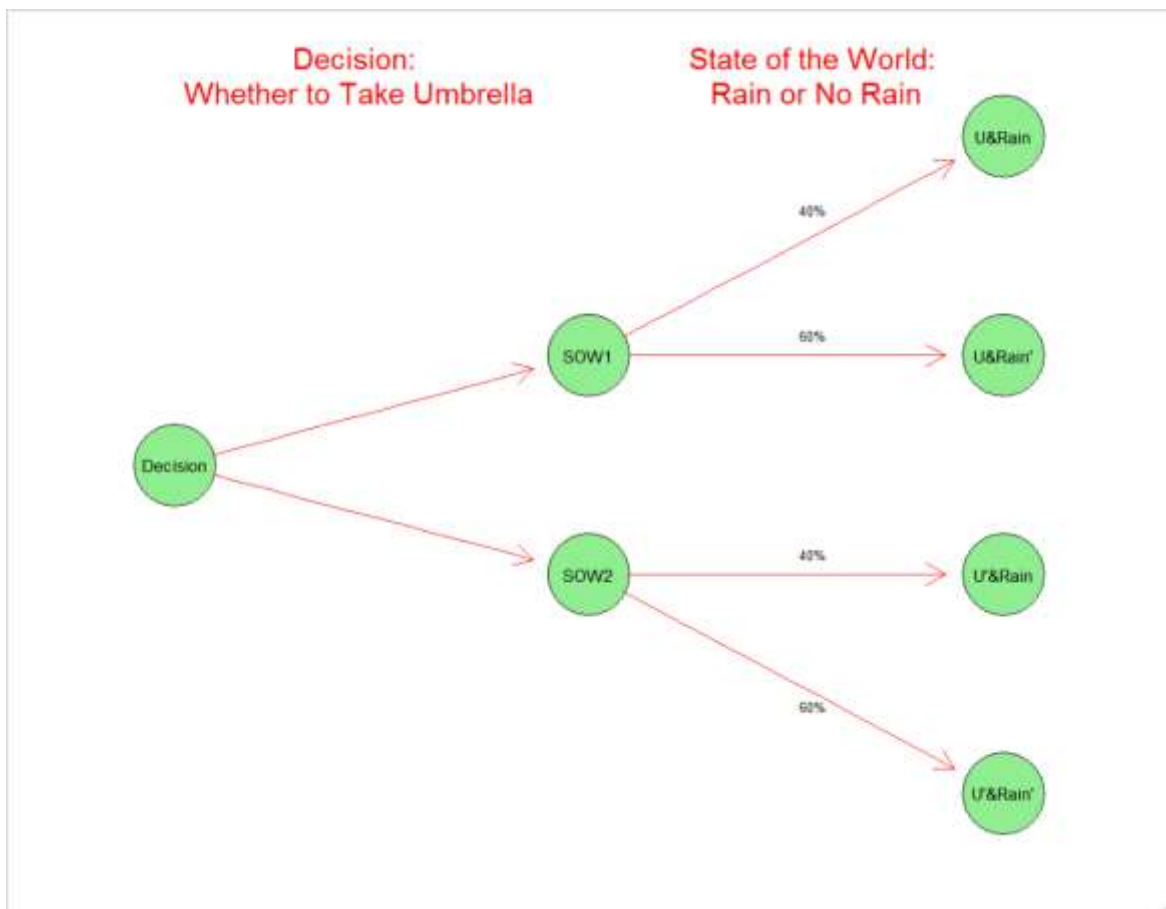
$$= prob1 * Value\ of\ Outcome1 + prob2 * Value\ of\ Outcome2$$

Where *prob1* is short for probability of event 1 occurring and Outcome 1 represents the value or result of outcome 1.

But: $prob2 = (1 - prob1)$; so,

$$EV = prob1 * Value\ of\ Outcome1 + (1 - prob1) * Value\ of\ Outcome2$$

Here is the formal representation of the umbrella problem using classical decision-making under uncertainty:



Conceptually, we are going to build a model in which we make a choice recognizing that the value of our outcome depends on whether it rains, or, formally, on the resolution of the “state of nature.” The model is laid out above; it is read from left to right.

The decision is framed in the square “decision-box” where we can see that confronting us is a choice. The choice is whether to take an umbrella. The two circles represent the “resolution of the state of nature” and the two lines leading outwards of each of the box represents the probability of each of the two possible outcomes occurring.

The numbers on the right are simply a listing of the four possible outcomes, where higher values, in this case, are preferable. As we can see, being wet tends to score a low value. Being wet was the result of choosing to not bring an umbrella when it poured.

We find out the outcome of a gamble (Outcome1) along with its chances (*prob1*) of occurring. Logically, there has to be at least one other plausible outcome for there to be any uncertainty. So, we find the chances of the second outcome occurring should be the chances of the first outcome not occurring ($1 - \text{prob1}$) times the value of the second outcome (Outcome2).

The expected value of the first outcome is equal to $\text{prob1} \times \text{Outcome1}$: $40\% \times 40 = 16$. Equivalently, the expected value of the second outcome is equal to $(1 - p1) \times \text{Outcome 2}$: $60\% \times 30 = 18$. It follows that the *expected value of the gamble is the sum of the expected value of each individual outcome*.

So, what is the decision? There are four possible outcomes, each with its own probability of occurring. Thus, the expected value of each choice is the expected value of the gamble, the resolution of the state of nature.

Thus, take the umbrella scores at:

$$EV|_{\text{umbrella}} = 0.40(40) + 0.60(30) = 16 + 18 = 34$$

And, not-taking the umbrella scores at:

$$EV|_{\text{no umbrella}} = 0.40(10) + 0.60(60) = 4 + 36 = 40.$$

Our decision rule instructs us to choose the path with the highest score. Accordingly, we do not take the umbrella. This is a powerful outcome. Now we have an ability to make informed decisions about whether to accept a gamble. It is, in effect, a method of dealing with risk. At least, it is a method we *should* use.

Who does that? Think a bit: When was the last time you relied on the algorithm above when deciding to take an umbrella with you?

More likely, we just look up at the sky and determine if the cloud cover is dark enough. If it is, we take our umbrella. And sometimes, we end up soggy and regretful.

Rather than relying on the above algorithm, humans resort to decision-making *heuristics* – in this case, and for example, the “darkness” of the cloud cover. We make mistakes all the time. Because we make decisions based on shortcuts, gut, instinct, custom, rumor, gossip, hearsay, authority. For the most part, we never consider the choice directly or deliberately, much less mathematically.

Consider some personal examples of choice under uncertainty; you may recognize some of them.

- I know I should not eat carbs. My metabolism is slow. But I cannot refuse a slice (or two) of the pizza my wife brought home.
- I am aware of how a few beers can impair judgment. Yet I have been known to “tell myself” that I have above-average driving skills, and that this ability somehow immunizes me from any danger of driving after a few beers.
- I joined the gym last summer: with every intention of working out at least 3 times a week; we know how that turned out.

It’s as if there were two personas duking it out inside each of us for control of our decisions. We can be fairly certain that, had we taken the trouble of sitting down and relying on the expected value algorithm before deciding, we would have gotten the “right” answer. The Behavioral Economics revolution formalized what is self-evident: *We don’t behave the way we should.*

Limitations of Expected Value

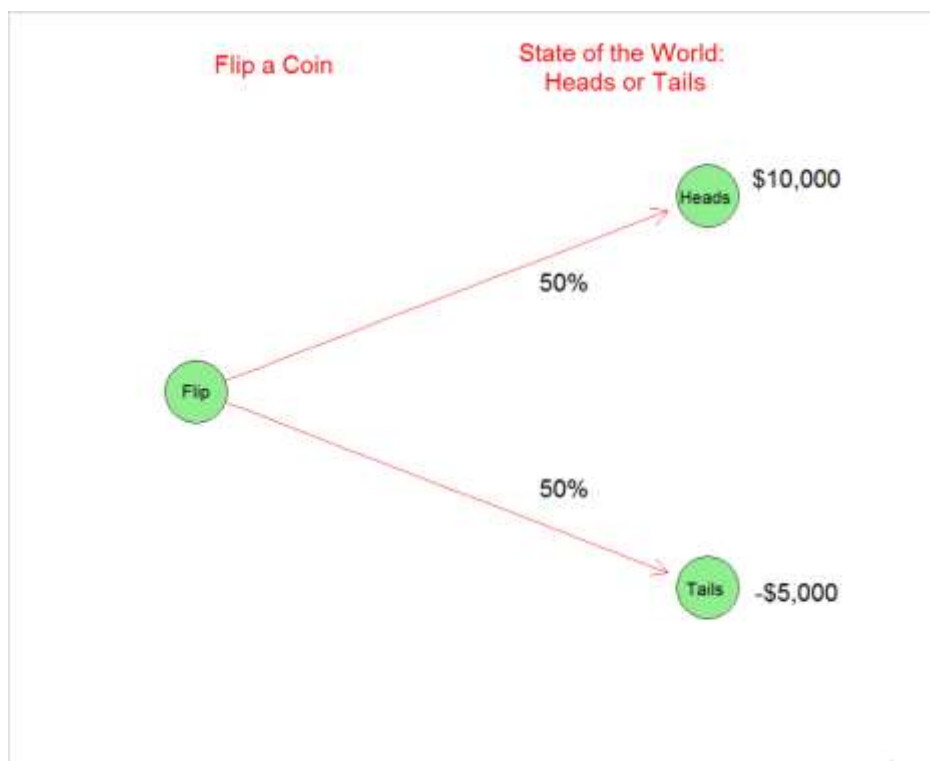
Despite its pedigree, there are well known limitations and criticisms of the *Expected Value Method*. Some are associated with the rise of Behavioral Economics, some are older.

The first challenge to the Expected Value paradigm has come to be known as the St. Petersburg paradox. Its outcome rebuffed the decision-making guidance provided by the Expected Value analysis.

The St. Petersburg Paradox

The Paradox concerns a gamble. It sets forth the following game and prompts you to offer how much you would pay to play the game. There is an initial pot of \$1.

Would you take the following gamble? On a flip of a fair coin you win \$10 if heads or lose \$5 in tails. A coin where either side has an equal chance of occurring is called a fair coin. Generally, a gamble with equal chances is called an actuarially fair gamble. This is the decision chart.



$$EV = (1/2)*(10) + (1/2)*(-5) = \$2.50$$

$EV > 0$ so yes, take the bet.

How about this one? On a flip of a fair coin you win \$10,000 if it comes up heads or lose \$5000 if it's tails:

$$EV = (1/2)*(10,000) + (1/2)*(-5,000) = \$2,500$$

$$EV > 0$$

Most people would decline this second, gamble. In fact, in laboratory situations, people *have* declined it. Daniel Bernoulli

appraised the situation and recognized that the Expected value of a gamble did not reflect people's real-life decisions. Largely for two reasons. First, people placed different values on a commodity like money, depending on their desires and circumstances. Second, a specific amount of money was more important to people who had very little than to people who have very much. So, there was little appeal of the possibility of a large gain when attached to the possibility of a large loss.

In the formal mathematical treatment of the St. Petersburg Paradox, the game is described as an infinitely repeated coin toss. The expected value, therefore, is infinitely large – indicating that an average person should be willing to wager an infinite amount of money!

Bernoulli was perhaps grappling with the reason for the contradiction between what we ought to do when confronted with money and what we actually do. Echoing Gary Marcus and Steve Pinker, Tom Sowell describes it:

It is human nature to think that every object has an intrinsic value (as opposed to being worth whatever people are willing to pay for it at the time), that middlemen are parasites (despite the service they render in gathering goods from distant places and making them conveniently available to buyers), and that charging interest is immoral (despite the fact that money is more valuable to people at some times than at others).

To overcome the problem, Bernoulli advanced the concept of what we now call *utility*, defined as the subjective value placed on some good or action. This characterization of subjective value slipped easily into the existing framework as the *Expected Utility* (of a gamble) model.

$$EU = \text{prob1} * U(\text{Outcome 1}) + (1 - \text{prob1}) * U(\text{Outcome 2})$$

The decision rule, naturally, was suitably altered: Maximize – or pursue – the alternative that promises the highest Expected Utility. To state the obvious, this is a model of rational choice that assumes well-defined and consistent preferences, the ready availability of probabilities of occurrences, known number and nature of outcomes, and that individuals maximize Expected Utility. This new twist results in a restatement of solving the problem of uncertainty – in a manner that was familiar to us.

But even with Bernoulli's huge conceptual fix, there existed problems with the model – which provoked considerable debate and anxiety in the profession – yet were routinely dismissed as anomalies. The questioning started rather early.

The Allais Paradox

One of the first challenges to the explanatory power of the Expected Utility model came from Maurice Allais in 1953 – who posed what is known today as the Allais paradox. Allais illustrated how individuals' actual decisions can be inconsistent with expected utility theory.

Allais set forth the following experiment: an individual is asked to choose one between the following gambles:

Gamble A: 100% chance of receiving 1 million

or

Gamble B: 10% chance of receiving 5 million, &

89% chance of receiving 1 million, &

1% chance of receiving nothing

And from the following:

Gamble C: 11% chance of receiving 1 million, &

89% chance of receiving nothing

or

Gamble D: 10% chance of receiving 5 million, &

90% chance of receiving nothing

Most people choose A in experiment 1. Most people choose D in experiment 2. In other words, most of us prefer a sure thing to a gamble.

However, alongside most people, if we choose the sure thing (A) over a gamble in experiment 1 and then D in experiment 2 we face a contradiction. Again, put simply, if we choose A in experiment 1 we reveal we prefer a sure thing to a gamble. But if we prefer D in experiment 2, we reveal we prefer a gamble to a sure thing.

And here is the proof (just a bit of rearranging).

Experiment 1 (*all values in millions*):

$$1U(1) > 0.89U(1) + 0.01U(0) + 0.1U(5)$$

Experiment 2 (*all values in millions*):

$$0.89U(0) + 0.11U(1) < 0.9U(0) + 0.1U(5)$$

Let's rearrange the last equation by subtracting $0.89U(0)$ on both sides:

$$0.11U(1) < 0.9U(0) - 0.89U(0) + 0.1U(5)$$

$$\text{To get: } 0.11U(1) < 0.01U(0) + 0.1U(5)$$

Now replace $0.11U(1)$ by: $1U(1) - 0.89U(1)$

$$\text{To get: } 1U(1) - 0.89U(1) < 0.01U(0) + 0.1U(5)$$

And last, subtract $0.89U(1)$ from both sides, to get:

$$1U(1) < 0.89U(1) + 0.01U(0) + 0.1U(5)$$

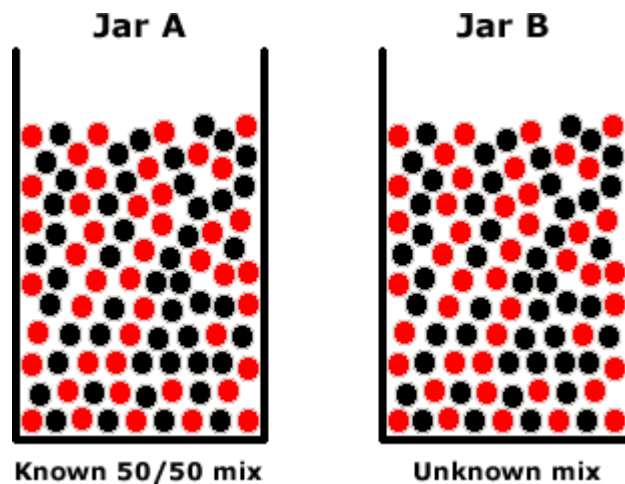
A contradiction, because the above is now telling us that we prefer a gamble to a sure thing.

It turns out that the differences in small probabilities (0 versus 1%) matter a lot more to us than differences in intermediate probabilities (33% versus 34%). This is called probability weighting, whereby the value provided is interpreted asymmetrically. This feature pervades our behavior when appraising risky alternatives. It exerts its influence from the purchase of lottery tickets to the bias towards vaccines and challenges the generality of the expected utility model.

The Ellsberg Paradox

The Ellsberg Paradox is attributed to Daniel Ellsberg, the economist perhaps better known for leaking the Pentagon Papers – the Edward Snowden of his time, the 1970's. Ellsberg's doctoral work was in human behavior and decision-making. Specifically, he studied how people make decisions under conditions of ambiguity – striking a distinction between ambiguity and uncertainty. What we now call the Ellsberg Paradox was one of his experiments.

To explain Ellsberg's Paradox, we resort to another ubiquitous urn (jars) model. In front of you are two large jars.



The jars are covered so you can't see inside them. The urn on the left contains 50 red marbles and 50 black marbles. The urn on the right also contains 100 marbles, but the ratio of red to black marbles is unknown; every ratio is as likely as any other.

Here is the gamble. If you can draw a black marble in one pick, without looking, you win \$100.

From which jar do you draw: The one on the left or the one on the right?

Which jar did you pick?

What Ellsberg found is that people overwhelmingly choose to draw the ball from the jar with a known set of probabilities, rather than take a chance on the urn with an unknown ratio.

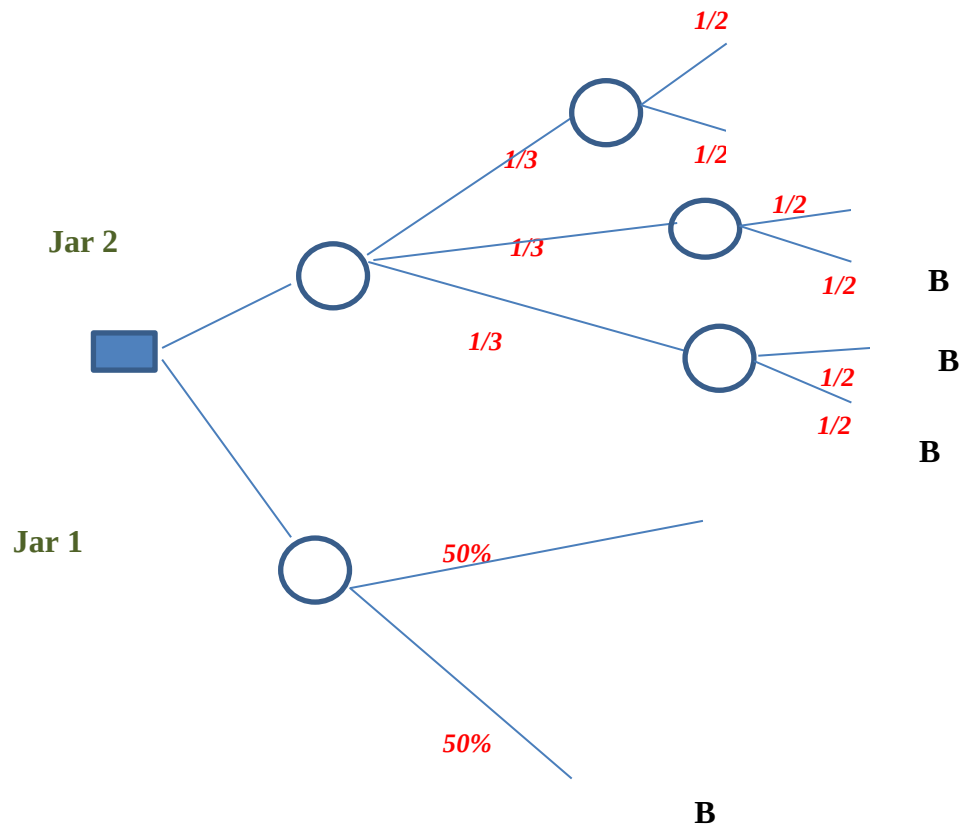
This is despite the fact that the second jar could have better odds of drawing black marbles, like 99 to 1 or even 100 to no red marbles. Of course, the ratio in the unknown jar could also be tilted in the other direction. There is no way of knowing. But as it turns out, the probability of drawing a black marble from either urn is identical.

To understand this, simplify the example a bit. Instead of 100 marbles, imagine there are only 2. In the known urn, there is 1 black

and 1 red. In the unknown urn, one-third of the time you'd be picking out of an urn with 2 black marbles. Another third of the time, 2 red marbles. And another third of the time, the urn has 1 of each.

When you sum these probabilities up, you see that the chance of picking a black marble in the second urn is identical to picking one from the first urn: 50%.

The decision rule of the conventional model, the model of decision-making under uncertainty, tells us that we should be indifferent between the two jars (gambles) because they have the same expected value.



To calculate the outcomes of each alternative gamble let the utility of drawing a black marble be equal to 1 and the utility of a red marble be equal to 0. Thus,

$$\begin{aligned}
 EU_2 &= 1/3[\frac{1}{2}(0) + \frac{1}{2}(0)] + 1/3[\frac{1}{2}(0) + \frac{1}{2}(1)] + 1/3[\frac{1}{2}(1) + \frac{1}{2}(1)] \\
 &= 0 + (1/3)(1/2) + (1/3)[(1/2)+(1/2)]
 \end{aligned}$$

$$= 1/6 + 1/3 = 1/6 + 2/6 = 3/6 = 1/2$$

And the second gamble

$$EU_1 = \frac{1}{2}(1) + \frac{1}{2}(0) = \frac{1}{2}$$

And therefore,

$$EU_1 = EU_2$$

So, we should be indifferent between the two gambles. But we don't. And we pick the first one. Even if the probabilities and expected outcomes and the paradox are explained, Ellsberg found that a significant number of people still *strongly preferred the first jar!* People exhibit strong aversion to ambiguity. Most of us have an inherent preference for the known over the unknown.

Downward Sloping Supply

“Cabbies in New York can work up to twelve hours a day. On rainy days, the demand for cabs is much greater than on sunny days. Cabbies are allowed a “rain-premium” supplement on rainy days to accommodate the increased demand.

The conventional rational choice model, where people respond to incentives, leads to a familiar prediction: The supply of labor will increase with a temporary increase in wages; and, symmetrically, the supply of labor will decrease with a temporary decrease in wages. So, the classical model would tell us the following: A cab driver will work longer on rainy days – where she is earning more; and less on sunny days where she is earning less.

But, put yourself in the cab driver's shoes: You are four hours into the shift on a rainy day. By now you have already covered your rental fee and then some, because you have been busy with high-dollar fares the entire time. You have earned more in four hours than you normally do in your entire 12-hour day. Do you keep driving and

complete the shift or do you leave for home early, satisfied that you hit your day's target?

A famous paper describes the result of this situation: New York cab drivers work less when they are earning more per hour, and work more when earning less per hour. This implies a mind-blowing downwards sloping supply curve!!! Does this matter for their incomes? Yes. If the same drivers had simply worked longer hours on good days and shorter hours on bad days, like predicted by the REM, they would have earned 10 percent more for the same hours of work!!

As a not irrelevant aside, consider where that 10 percent ends up. In the pockets of Uber drivers, of course. New business models succeed by exploiting such opportunities.

Why do cab drivers behave like this? As we will see in more detail later, when we start into prospect theory – the meat of Behavioral Economics – this is because of *Reference Dependence*. Succinctly, context matters; it's all relative.

Cab drivers set forth an earnings goal for each day and they are satisfied if they earn more than the goal and disappointed if they earn less. So, cab drivers work more until they've earned more than their reference point and then they stop. By thinking about each day in terms of a target reference point, the cab drivers ensure that they earn their desired pay, even if they don't efficiently allocate their time in the way predicted by economics.

In later chapters, following some introductory and interesting discussion on optical illusions, we turn to Kahneman's *Prospect Theory*. Prospect Theory relies on two main concepts: *Probability Weighting* and *Reference Dependence* to explain what people value. Probability weighting means that people treat some changes in probability as more important than others. As shown in the Allais Paradox, people treat the difference between 0 and 1 percent as considerably more important than the difference between 33 and 34 percent – even though each has a similar effect on one's expected utility.

Reference dependence means that people make decisions based on the perceived changes from some reference point. In the New York cab drivers example, the cabbies did not think about the effective rate for which they were laboring. Rather, they used their typical day's earnings as a reference point, and they tended to quit when they reached that reference point.

Before moving on to optical illusions, prospect theory, etc., we shall spend a moment discussing the value of NOT taking the time to rationally, mathematically, calculate expected values before acting.

How Heuristics Saved Us

In the umbrella problem, you could have incurred two kinds of errors in relying on the darkness of clouds as your decision-making gauge, that is, as data or evidence. You could have concluded rain and taken the umbrella. Lo and behold, it doesn't rain. This is a *false positive*. It is a positive because you interpreted the dark clouds as an indicator of rain. It is false because it did not rain.

On the other hand, you could have concluded no rain and left the umbrella at home. It rains. This is an error called a *false negative*. It is negative because your indicator, your evidence (the dark cloud) told you that it was not going to rain. It is false because it rained.

Every time you make a decision based on a metric, a measure, or a heuristic, you are likely to incur either one of these errors. If you consider the question in reverse and in the context of evolution, it is huuuuuge! Not all errors are equal. A false positive – not being able to associate sounds in the bushes with a predator – or ignoring movement in the far jungle probably led to many of our fellow cavemen not making it through the day. Only those who quickly responded to sounds and movement avoided the ultimate false positive: They lived. And, without extended analyses, algorithms, and rational thought processes, they lived long enough to pass on their genes to the next generation.

Readings

Colin Camerer, Linda Babcock, George Loewenstein, Richard Thaler,
“Labor Supply of New York Cabdrivers: One Day at a Time,” The
Quarterly Journal of Economics, Vol 112, Issue 2 (1977) pp: 407-441

[Daniel Crosby](#)
[Psychology Today](#)

LECTURE VIII: PERCEPTUAL ILLUSIONS AND RELATED THOUGHTS

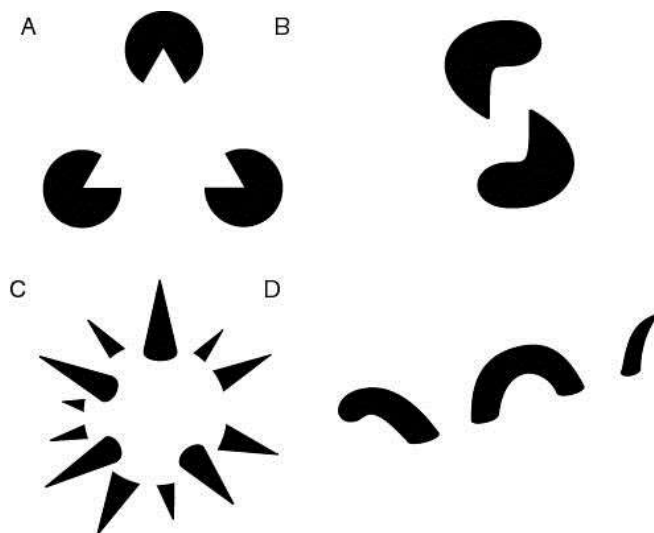
“Who you gonna believe, me or your lying eyes?”.

Chico Marx

The eye sees what is sees, even when we know what we know.

M. Piattelli-Palmarini

Consider the images below.¹⁰



It is almost necessary for anyone seeking to explain cognitive illusions (anomalies, heuristics) to resort to optical illusions. Something like an anomaly gateway. The most perplexing thing

¹⁰ Source: demonstration of reification in perception from Lehar S. (2003) *The World In Your Head*, Lawrence Erlbaum, Mahwah, NJ. p. 52, Fig. 3.3.

A: Standard Kanizsa triangle. B: Peter Tse's Volumetric Worm. C: Idesawa's Spiky Sphere. D: Peter Tse's Sea Monster.

about optical illusions – and their appeal as a pedagogical analogy - is their persistence and imperviousness to logic or explanation. It is indeed easy to be “fooled” via optical illusions. We humans are equally susceptible to cognitive illusions. In addition, humans are incapable of avoiding the effect of visual illusions even when its machinery is explained and understood. Again, a similar non-binding effect happens to us when we become aware of the pitfalls of cognitive heuristics: It is very difficult to avoid heuristics – even when we understand them!

We are now increasingly aware of the pitfalls of cognitive foibles – and aware as well that they are, somewhat ironically, part of our evolutionary survival toolkit. A heuristic is an evolved mental adaptation, a strategy used to solve specific problems. In the instances represented by the images above, the brain “fills in” the empty spaces in a manner that is most useful to the task at hand. It does so by relying on analogical thinking and pre-established, familiar categories. This process of replacing or imputing into a situation, event, video, or image is called reification: We “see” much more than is actually there.

For instance, a triangle is perceived in picture A, though no triangle is there. In pictures B and D, the eye recognizes disparate shapes as “belonging” to a single shape. In C, a complete three-dimensional shape is seen, where in actuality no such thing is drawn.

There are, of course, examples with more gravitas. Consider the following questions.

- How likely is it that a rabbit will also have a Golgi given that plants, insects, and humans have one?
- How probable is it that a swan egg will also contain biotin, given that duck eggs and goose eggs contain it?

In both instances, the whimsical perceptual illusions and the classification tasks, it is logically impossible to justify an intuitive

judgment. It is delivered on the basis of a general principle of which we are less certain.

Nirvana Fallacy Again

In economics, there are many instances of *reification*. As we have learned, the model of perfect competition that you were taught in your introductory courses does convey a lot of insight. But its operation – and predictive success – requires perfect information, homogeneity, numerous firms, and other restrictive features that are rarely present in actual markets. These features are generally referred to as *simplifying assumptions*.

Thus, inferring more from the model of perfect competition than what is there, an instance of reification, is a mistake. The model of perfect competition is a model, a representation. To draw broader inferences is a fundamental mistake, an abuse with a long presence in economics. To be fair, the theoreticians are aware of the limitations of their model. It is most likely others, the consumers of the model, that impute or attribute policy prescriptions far beyond what the model itself claims. To paraphrase Andrew Lang, politicians use economics the same way that a drunk uses lamp-posts – for support, rather than for illumination.

For example, one of the most important takeaways for purposes of policy is noting that the model of perfect competition holds that prices are equal to their marginal cost, when in equilibrium. This logic then implies that markets in which prices are greater than marginal cost raise a presumption of non-competitiveness or even anti-competitiveness. These model conclusions were married to the observation that cartels or cooperative ventures have the ability to constrict supply and raise prices. Upon adding two plus two, politicians and policy makers arrived at the conclusion that all supramarginal prices (prices above marginal costs) are anticompetitive and indicative of collusion and should necessarily trigger an antitrust enforcement action.

Overplaying the lessons from the model has elicited criticism. One of the better known is Howard Demsetz's *Nirvana Fallacy*.¹¹ So far as economics is concerned, the Nirvana Fallacy contains three elements. First, we tend to ignore the costs of corrective economic policy interventions by government but account for costs on consumers and on the economy. Running two federal antitrust bureaus, fifty state counterparts, and units in every foreign country, including some supraregional efforts like the competition capabilities of the WTO is quite a costly enforcement apparatus. Second, the model is driven by efficiency considerations and disregards the true tastes and preferences of consumers in economies who possibly rank, given the disparity in wealth, equity considerations higher than they do economic efficiency considerations (getting prices right). Third, analysts often assume that markets are perfectible. Gasp! This perfection is unattainable.

Markets are what they are in response to any number of institutional, normative, and historical accidents and considerations. They resemble the model of perfect competition probably only by coincidence. To assume that the model of perfect competition represents the real world is to put the cart before the horse.

The Tragedy of the Commons

Another example of stretching a model is Garret Hardin's Tragedy of the Commons. The village commons in yesteryear England was a pasture that belonged collectively to a village. Everyone in the village grazed cattle or sheep on the commons. As the number of animals owned by the village approached the carrying capacity of the commons, the problem took the following form.

¹¹ Harold Demsetz, Information and Efficiency: Another Viewpoint, 12 JOURNAL OF LAW AND ECONOMICS 1, 1 (1969).

In bringing an additional cow onto the commons, the grazing provided gains to the individual cattle-owner-villager, but the equivalent incremental costs were distributed over the entire community. Thus, the individual villagers did not experience the costs beyond the direct, immediate ones. As a result, benefits outweighed the individual costs and constituted an incentive for the individual cattle-owner to continue bringing his livestock. In fact, every member of the village was motivated to keep adding cows. The tragedy is that, over time, the grazing outstripped the carrying capacity of the commons and it went fallow, to the detriment of all.

The reification occurs when the tragedy of the commons becomes the unfiltered template or lens through which we analyze other “common-resource” problems: the plight of the buffalo, global warming, ivory sales, and many, many others. In its pure form, the “solution” to the tragedy of the commons travels as well. The logical, or, at least, frequent, solution is that the State becomes the sole mechanism for incorporating externalities into the decision-calculus of the individual. In fact, this model unequivocally recommends the State for all sorts of social dilemmas, echoing Hobbes. But contrary to the model, humans are not predisposed to live like the young men in in the *Lord of the Flies* or Hobbes: “...solitary, poor, nasty, brutish, and short.” Nor do we constitute “two distinct species of men, the good and the bad,” to continue in a Hobbesian / Golding frame.

We have Elinor Ostrom to thank for righting that theoretical snafu. In 2009 Professor Ostrom was deservedly recognized with a Nobel Prize in Economics. She studied how people in small communities around the world managed common resources. Her research showed that when natural resources are pooled and have shared ownership, the rules for managing those resources evolves over time in a way both economically and ecologically sustainable. Professor Ostrom severed the unquestioned adaptation of the commons framework and its theoretical solution from the real world. Common pooled ownership of natural resources is a historical and, possibly, a better alternative, to both privatization and government involvement.

Indeed, a keen takeaway is the observation that when individuals have to answer for their actions to others who depend on the same resources – such as fishing grounds or common pastures – their approach to shared responsibility changes and the “solutions” change. More broadly, Professor Ostrom’s insights have applicability across all forms of social organization.

The Texas Sharpshooter Fallacy

It is obvious that every individual thing or event has an indefinite number of properties or attributes observable in it, and might therefore be considered as belonging to an indefinite number of different classes of things...” John Venn (1866)

We are prone to settle arguments in our social discourse by appealing to data. Data driven outcomes trump any dissent - except when they don’t. And the latter occurs with increased frequency because often in policy debates, data trotted out is based on *available and measurable* attributes of the policy issue under scrutiny. This is the case even though we understand and rue the fact that the full complexity of the issue is not captured by the chosen metric.

This feature of social behavior is well known to behavioral economists. Our understanding of a complex argument is rendered easier to understand when the elements of an analysis are starkly laid out and juxtaposed instead of an analysis that consists of nuanced and possible inconclusively balanced arguments. We answer the question we know instead of the question we were asked.

Confronted with complexity and uncertainty in decision-making individuals and interest groups turn to socially embedded narratives and schemas to understand extant social, economic and political landscapes, thereby forging the beliefs that aid or direct their choices.

Consider the case of Connecticut – and elsewhere in the country where the election season, in combination with economic weakness,

appear to have reenergized the perennial issue of the disparity between the rich and the poor, the haves and the have-nots (Mankiw, 2010). The claim, with notable variations and enhancements, is that the seeming increase in the alleged disparity is the root of the present economic malaise. One would think that this polarizing issue could easily be settled by simply gathering data and testing the proffered hypothesis, to wit: That the observed disparity has worsened over time. The significance of data must be construed; in fact, the creation of data – is a construal. And in the construal of data we cannot avoid our cognitive limitations. Unfortunately, cognitive heuristics are not the only fissure in the analysis.

There are several other significant methodological problems that make the data-marshalling exercise less compelling. First, individual metrics chosen and assembled for a particular inquiry do not necessarily reflect the broader policy concept. For example, setting aside the fact that no particular metric is *a priori* privileged over any other, one would think that the first step in settling the dispute would be to gauge the changes in some measure of inequality over the relevant time period. Probably because of its first-in-time feature the *Gini coefficient* appears to have pride of place in this role – despite its imprecise mapping of the narrative.

The Gini coefficient, calculated for a state or country, is a dimensionless number that captures the existing divergence in wealth – or income – along a theoretical range of possible outcomes. At one extreme of the range is a distribution of wealth – however measured - in which everyone has the same income. The other extreme is one in which all income accrues to one individual.

In the state of perfect equality, the Gini coefficient would be equal to 0; in the state of perfect inequality the Gini would be equal to 1. The Gini is continuous, so a measure of the actual distribution of widgets between the two putative groups would result in a coefficient ranging from 0 to 1. The higher Gini coefficient implies a less egalitarian distribution of widgets. But the problem is that the Gini

coefficient is likely to change depending on the “widget” we choose and on how the contrasted groups are assembled.

Importantly, the usage of either wealth or income is often left unclear (Weicher, 1997). Wealth is the stock of assets that people own at a given time. These include stocks, bonds, homes and other real estate or businesses. Income is the money people receive over a period of time; some income comes from wealth, such as interest or dividends, but most incomes are derived from work; from employment.

Pointedly, before any technical calculation can be deployed we are left with resolving the following: What measure of widgets does one use to calculate the Gini coefficient (or any other metric) and across what groupings? The goodies we count could be individual income, property wealth, household income, pre-tax or after-tax income, life-time income or income at a certain moment in time. Do we exclude parks, greenery, air quality, hiking trails and other similar environmental assets? More generally, do we include non-pecuniary attributes of inequality, infrastructure, social capital, and environmental amenities? Across what groupings are we comparing? We are fond of racial, ethnic, regional, and gender divides in our policy discourse. All are attributes across which one could find considerable divergences among and between groups.

One can appeal to theoretical rigor, yet find that by its very nature, theory lacks precision. Theories, by definition, encapsulate broad analytical categories to enable generalized statements and their treatment. Moreover, many sound and persuasive theoretical arguments can be set forth, but none definitely. Thus, inevitably, one needs a theory to select an *applicable* theory – and so forth, *ad nauseum*. Ultimately, it’s a judgment call, based on presumably theoretically-informed, commonly-held beliefs restricted by data availability.

A second, related problem is equally vexing. In its different disciplinary appearances and representations, it is known variously as the *reference class problem*, the *partition problem*, or the *Duhem-*

Quine Critique. Because it is more illustrative – one based on an actual and recent court case – in which the ambiguity of the reference class conundrum was starkly laid out, the authors prefer to call it the *Shonubi Problem*.

In the early 1990's a Nigerian citizen named Charles Shonubi was arrested in New York's Kennedy Airport for swallowing and smuggling heroin-filled balloons into the country. Shonubi was tried and convicted in federal court. The sentence accorded a person convicted for smuggling controlled substances depends on two interrelated probative elements: The quantity of narcotics seized and the total quantity handled as part of the same course of conduct or common scheme or plan as the offense of conviction (U.S. Government, 1995).

Given the sentencing parameters, the District Court took into account Shonubi's prior trips to and from Nigeria with the implicit assumption that the trips were likely to have occurred for the identical purpose of ferrying heroin. The court record showed that he had made seven trips prior to his arrest. As a result, Shonubi was sentenced based on the total quantity of drugs in his possession on the trip when he was apprehended, combined with an *estimate* of the quantity of heroin smuggled on the seven prior trips for which he had not been formally charged. The estimated quantity imputed was a statistical approximation based on data derived from the amounts of heroin recovered from the arrests of heroin smugglers. Ultimately, however, the US Second Circuit Court of Appeals did not allow the statistical evidence in question. Shonubi was sentenced based only on the quantity of drugs in his possession when apprehended.

Despite the fortuitous outcome (at least for Shonubi) the problem visited in the case is a general one exemplifying as the reference class problem or as the partition problem. The problem arises because there is no *a priori* way to privilege one classification over another and therefore any proposed outcome is infinitely malleable. Any rhetorically skilled, clever analyst or researcher can arrive at any

background number he / she wants as long as he / she manipulates the reference class sufficiently.

The problem is neither limited to law enforcement nor a theoretical oddity (Colyvan & Regan, 2007). It appears in practical applications with great frequency, including in the most quotidian of situations. For example, when real estate appraisers value property for sale, taxation, eminent domain or insurance, one standard method is to look at comparable properties. But which properties are in fact “comparable” and what attributes of a home or lot should be used for the valuation? Whereas we routinely reach for theory for guidance, no theory can specify the empirical elements precisely. Thus, the choice of reference class can affect the valuation considerably.

One of the authors has, on more than one occasion, saved the careers of clients who found themselves on probation because their division’s market share had declined – usually after a price increase. We paid more than one college tuition with fees earned from arming said client with the data to demonstrate that his division’s *share of the premium-priced market* had actually gone up!

In criminal courtrooms, statistical analysts often set forth the probability that a person chosen at random from the population will have the same profile as the one found at the crime scene. This is known as the *random match probability* (RMP). Yet, the outcome of the random match probability depends on the attributes of the population chosen by the analyst to frame the comparison. Consider the many possible applicable area and racial groups. The RMP will vary based on whether the applicable area is the national population, state, or the particular metropolitan-statistical-area in which the crime occurred or whether it is based on all citizens or only those of the defendant’s particular racial sub-group.

The above discussion may seem somewhat picayune. After all, there are reasonable, commonly established, and accepted boundaries that define the partition set at hand. In fact, to a large extent, these boundaries have been defined by common practice, are often embedded in legislation and institutionalized in either formal or

casual use. For example, using the category of individuals over age forty as a category of analysis to appraise the impact of discriminatory practices is firmly established by law – despite the fact that it is entirely arbitrary.

It is clear that the measurement problem and the partition problem cannot be avoided. It is equally clear that the need for operationalizing conceptual issues cannot be avoided. The degree to which the poverty, wealth, socioeconomic status, culture, and gender can impact – bias – decision-making by the state, the electorate, and the private sector in their apportionment deserves study. Try a thought experiment: Do you think our laws might be different if the majority of members of Congress – of both Houses, of both parties – over the past fifty years had been more nearly representative of the U. S. population as a whole, rather than vastly over-representing rich, white, male lawyers?

Importantly, the categorization construal is not immune from cognitive triggers. Consider the [seasonal hoopla over excessive and abusive government spending](#) that is almost a ritual of our political system. Abusive government is so routine that hardly anyone pays attention anymore. And we when do, it is difficult for us to fathom whether 30 billion dollars for a state of the art jet fighter is a good deal or not. But even today, we remember the bile and outrage elicited by the infamous \$640 toilet seat, and the \$7,600 coffee percolator incident. Why is that incident so memorable? Here is William Hartung's take on the matter:

[*This may be because the average person doesn't have a sense of what a fighter plane should cost, but can more easily grasp that spending \\$640 for a toilet seat or \\$7,600 for a coffee pot is outrageous.*](#)

Quantification, peccadillos big and small notwithstanding, can improve our understanding of a concept that concerns issues of great practical relevance. It's on us to be wary.

Is Free Will an Illusion?

We end this chapter with a more interesting question: Is free will an illusion? Consider the argument set forth by Michael Gazzaniga. Gazzaniga reports on experiments in which subjects with severed left and right hemispheres of the brain would perform actions in response to visual stimuli delivered to the right brain. The individual would perform the requested action and then the left brain – the language center – would provide an “explanation” for the action – without any knowledge of the initial request. Here is in Gazzaniga an interview in Scientific American being interviewed by Gareth Cook:

Cook: *Do you think that neuroscience, as a field, needs to tackle these questions? That is, do you consider free will an important scientific question?*

Gazzaniga: *We all need to understand more about free will, or more wisely put, the nature of action. Neuroscience is one highly relevant discipline to this issue. Whatever your beliefs about free will, everyone feels like they have it, even those who dispute that it exists. What neuroscience has been showing us, however, is that it all works differently than how we feel it must work. For instance, neuroscientific experiments indicate that human decisions for action are made before the individual is consciously aware of them. Instead of this finding answering the age-old question of whether the brain decides before the mind decides, it makes us wonder if that is even the way to think about how the brain works. Research is focused on many aspects of decision making and actions, such as where in the brain decisions to act are formed and executed, how a bunch of interacting neurons becomes a moral agent, and even how one's beliefs about whether they have free will affect their actions. The list of issues where neuroscience will weigh in is endless.*

If free will is an illusion, why do we hold on to such a belief? We will turn later to explanations of beliefs; more specifically, why we hold certain beliefs. Gazzaniga gives us a lead:

In many ways we humans, in achieving our robustness, have uploaded many of our critical needs to the social system around us so that the stuff we invent can survive our own fragile and vulnerable lives.

READINGS

Harold Demsetz, "Information and Efficiency: Another Viewpoint," *The Journal of Law and Economics*, Vol. 12, No. 1 (1969) pp:1- 22.

[Gazzaniga interview in Scientific America](#)

PODCASTS AND VIDEOS

ON THE CANCER CLUSTER MYTH

http://www.kuhf.org/programaudio/engines/eng1465_64k.m3u

AMAZING ANAMORPHIC ILLUSIONS

[CHARLIE CHAPLIN OPTIC ILLUSION](#)

[MATRIX TRAILER](#)

We respond to change

<http://www.sluggishvideos.com/season1/fighting-blue-sky-thinking>

LECTURE IX: HOOFBEATS

*Simply put, when you hear hoofbeats
behind you, think of horses not zebras.
Dr. Theodore Woodward*

Consider the following example: Who won the 2016 Euro Cup? If you know your way around soccer you might have a ready answer. But suppose you aren't a soccer fan and you did not see anything about the prospects of each of the teams competing. But you know a player in the tournament because you may have seen him on TV commercials or you may have seen him playing in the America's cup, which was held here in the US during the summer of 2016: Lionel Messi

Darn! you remember reading that Messi is Argentine. So, Argentina, as a possible guess, is out. However, you have seen commercials of another player that many claim is as good as Messi: Cristiano Ronaldo. From Portugal. You, therefore, pick Portugal as the winner, on that basis alone. And you would be right: Portugal beat France to win the 2016 Euro Cup.

This is an example of the *familiarity* or *availability heuristic*. People think that familiar things are better, more valuable, more likely, more frequent and in the case of sports, more likely to win.

How does this process fit the definition of heuristic?

- It “tunes out the noise.” Put differently, it ignores some available information. All useful information – some data, much data – is ignored.
- It prioritizes some information. In the example above, a single fact is used: There is a famous player, Cristiano Ronaldo, from Portugal.

- It makes the decision-making process faster with less consumption of precious resources. It is quick and almost effortless to think, “I’ve heard that Cristiano Ronaldo is from Portugal.”
- It leads to an accurate decision. Your task was to predict the winner. Despite the fact that the event had already occurred, no one knows the answer; it’s uncertain. Accuracy does not mean that the heuristic leads to the right prediction. Instead, it means that using the heuristic improves our chances of making the right prediction. In this case, is familiarity a positive predictor of winning?

Heuristics are almost always faster, almost always less effortful, and often but not always more accurate than other decision-making processes. Using a heuristic may be our best approach when we don’t have much information. And they often work well even when we do have lots of information.

They are not necessarily emotional – although some are. We can make effortless decisions without feeling sadness or anger or any other emotion.

Heuristics are often special cases of *bounded rationality*. Bounded rationality arises from the presence and interaction of two factors when confronting uncertainty: Our own computational limitations and the existence of structure in the environment.

Because of the many ways our computational capabilities are limited and the various structures possible around us – in our environment – many sorts of heuristics affecting our decisions have been identified.

From Where Do Heuristics Arise?

Heuristics often operate without our conscious understanding of them. When we are conscious of them, we learn heuristics in two ways: We can discover them on our own, in that instinctive, natural way we are alerted to various human traits – aversion to foul smells, fear of loud noises, curiosity of gadgets and shiny objects, and so on. Or, we learn from others. Culture and norms of behavior embody practices that have been evolutionarily vetted to ensure our continued survival.

A deeper awareness follows from our understanding that heuristics are context-dependent. How does a particular context, or environment, dictate or signal the relevant decision-making heuristic? We shall now examine five important heuristics. Each of these five heuristics overcomes a particular sort of cognitive limitation and potentially, become a cognitive trap. The ***availability heuristic*** involves memory. ***Anchoring*** is based on valuation and reference points. ***Representativeness*** rests on estimation of probabilities. The ***affect heuristic*** derives from simulation of feelings and emotions. The ***fundamental attribution heuristic*** compels us to readily blame others.

The Availability Heuristic

We recognize something. The familiar is favored over the novel. It makes brand names more desirable. Makes violent crimes seem more common than they really are. It makes the occasional baseball fan choose the Mets over the Giants. Formally: the availability heuristic relies on the ease with which something can be brought to mind.

Consider the following question: Which city has a larger population, Philadelphia, PA or Lubbock, TX? How about Frankfurt

or Essen? Who lives longer, elephants or pangolins? American students score better than German students when answering the question about Germany – and vice-versa. Our sense of familiarity develops because of the structure in the world around us. Large cities tend to be culturally or economically significant – and therefore more familiar. Think about the German students: They were familiar with all the German cities, so familiarity was not a useful clue as to which city was larger. But familiarity did become a good guide to population when they were asked questions about cities in another country, the US.

What about elephants and pangolins? Most people guess that elephants have the longer average life span. And, they are correct. Larger, longer-lived animals are more familiar. So, our sense of familiarity tracks something meaningful.

But paradoxically, according to Gerd Gigerenzer, too much familiarity undercuts the benefits of familiarity. The most accurate judgment comes from those who are familiar with 75% of the items and will do better than someone who has heard of all the items. The structure of the world around us is determinative.

The familiarity heuristic impacts judgments of probability: People tend to overestimate small probabilities and underestimate large probabilities. The latter leads to sub-additivity where the total is less than the sum of the individual probabilities.

Consider the following example: Willis is 55 years old; a smoker; relatively good health; drinks, eats fatty foods; lives a sedentary life style. How likely is Willis to die of a heart attack? Stroke? heart disease? lung cancer? brain cancer? Melanoma? As it turns out, most people provide answers that add up to the fact that Willis has a 150 percent chance of dying from these causes. It is not surprising that, in isolation, we overestimate the risk of the causes.

The availability heuristic affects economic decisions: We invest in the stock of familiar companies. We invest in the stock of our own company, where our risks are correlated: If the company goes broke, we lose our job AND our savings.

The Anchoring Heuristic

The Anchoring heuristic uses some initial estimate – an anchor – to infer or estimate subsequent answers and decisions. When we don't have any information on which to base a judgment we latch on to any information before us. Anchoring is, in fact, a very common consumer mistake.

Car dealerships, for instance, have elevated their reliance on this heuristic to an art form. They first set an inflated “sticker” price for a car. No customer realistically pays that price – we all want to bargain. But what is not obvious to us is that the bargaining will necessarily start with an adjustment downwards from the sticker price set ahead of time. The resulting “negotiated” price will seem to anyone like a good deal – although you can bet that it is still higher than the salesperson's reservation price.

This operates because our brains cannot dismiss the sticker price as irrelevant, as we should. The useless factoid stuck in our prefrontal cortex will serve as a point of comparison, specifically as the point of departure for the round of bargaining. And because we pay attention to unnecessary information we end up paying more than we should. There is even a frequently-used phrase for this bargaining tactic: “Opening Negotiating Position.”

If you look up on clear night and attempt to count stars, you would come up with approximately a hundred thousand. Clearly, the galaxy contains many more. Does it contain more or fewer than 100,000? How many stars are there in the Milky Way? We have no personal experience; we have seen only a fraction of the number of stars. We cannot know the answer based on explicit knowledge or on personal experience, but we need something on which to base our answer.

Given our lack of information, 100,000 becomes an anchor; we infer it must be somewhat close to the right answer. So, we begin

there and adjust upwards or downwards. The anchor constrains the subsequent estimate. Let's guess 1,000,000 stars.

The answer, however, is that there are approximately 100 billion stars in the Milky Way. Our anchor was *one million times too low*. Because of the low anchor, our estimates are far too low. A much larger anchor, in turn, would have resulted in estimates that were too high.

Surprisingly, anchoring works even if there is no logical connection between the anchor and subsequent estimates. Even when the anchor is random it can still influence behavior. Anchors can be generated by roulette wheels or by the last two digits of a person's Social Security number. It has been documented in an experiment that students who had large (last-four digits) social security numbers are likely to pay more for various items at auction. In fact, students with higher numbers were willing to spend 300 percent more than those with low numbers.

Auctioneers are aware that anchoring plays a key role in the pricing products that are rare, infrequently purchased, or difficult to value. Cézanne's *Card Player* and Munch's *The Scream* are singularly valuable – unique, famous, and often referred to as “priceless.” The factors that determine the actual, real-world price of these pieces are numerous. Perhaps surprisingly, it matters whether the market is currently hot or cold. That is to say, pricing cycles in the art market impact pricing. Suppose a painting comes up for sale in a hot market; in few years the inflated selling price should influence the next market. The reverse works as well. The takeaway here is to look for pieces that last sold in a “cold” market. They are most likely underpriced.

What does the inability to overcome the susceptibility to anchoring – specifically, our inability to disregard superfluous information – bode for our functioning in this market surrounded by massive amounts of information? Herbert Simon said it best, “A wealth of information creates a poverty of attention.” Information has diminishing and even negative returns. When making decisions, we

all assume that more information is better. Thus, we see the corporate proliferation of “dashboards” and “knowledge banks,” intended to provide decision-makers with every imaginable piece of information. As the information available to us expands exponentially, our attention is increasingly strained and challenged. Counterintuitively, more is probably worse.

The Representativeness Heuristic

We often estimate probabilities through the following simple rule: Prototypical or archetypal events are likely events. Consider Rebecca’s job performance profile. She is intelligent, extroverted and gregarious. We also know that at an early age Rebecca speculated about space travel and she was good at math and good writer. Horses and cars are her current passions. She is willing to take risks. She is a good communicator.

If you had to guess what is Rebecca’s profession, which of the following would you choose: Teacher, Astronaut, Lawyer, or Science writer? Most people say astronaut, because the description sounds like a prototypical astronaut. People say that the least probable is either a lawyer or a teacher. But stop and think: Have you ever met an astronaut?

There are, at most, 100 astronauts at any one time. But there are at least a million teachers and many more than a million lawyers. And there are thousands of science writers. Clearly, it more likely that she is a teacher or lawyer. The number of science-oriented and risk-loving teachers and lawyers must be orders of magnitude greater than the *total* number of astronauts. Representativeness fails us as a heuristic in this context because these professions differ dramatically in their base rates. Teachers and lawyers are much more common than science writers and astronauts.

Why do we rely on this heuristic when it leads to obvious mistakes? Representativeness is a fast and simple guide to probability. A beautiful and clear morning suggests that it is unlikely to rain in the afternoon. Conversely, a cloudy day promises rain. Students with good grades are more likely to do well in medical school. The leading brand of toothpaste is a good product. Prototypes are often prototypes for a reason; often the best or most common member of a category.

Representativeness fails when prototypes are rare but succeed when prototypes are common. That rule provides clear guidance. Be wary when representativeness leads you to some rare conclusion. Simply put, when you hear hoofbeats behind you, you think of horses not zebras.

A now classic demonstration of the problems inherent in the representativeness heuristic is the “Linda Story,” an example of the **conjunction fallacy**, which originated with Amos Tversky and Daniel Kahneman. The conjunction fallacy occurs when it is assumed that *multiple specific conditions are more probable than a single general one*. The classic treatment begins with this setup: 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.

Which is more likely?

1. Linda is a bank teller.
2. Linda is a bank teller and is active in the feminist movement.

85% of those asked chose option 2.

The “and” in number two is very important, because it is the addition of those two conditions that make it both more specific *and* less likely than number 1.

This cognitive error violates axioms of probability:

$$\Pr(A) \geq \Pr(A \wedge B) \leq \Pr(B).$$

Translation: Conditions A & B, when taken together as they are in the middle of the equation, are less probable than A or B when taken alone, as in the extremities of the equation.

So, if we go back to our example, this means that if there is a 50 percent chance that Linda is a bank teller. There is a 95 percent chance that she is active in the feminist movement. Choice #1 has a 50 percent probability of being true and choice #2 has a 47.5 percent probability of being true ($0.5 * 0.95 = 0.475$). Tversky and Kahneman argue that most people get this problem wrong because they use the representativeness heuristic to make this kind of judgment: Option 2 seems more “representative” of Linda based on the description of her, even though it is clearly mathematically less likely.

This [representativeness heuristic](#) makes us see things that are more specific as more likely, which can partly explain why good fiction (and good lies) contain many specific and telling details. Mathematically, a simpler, more general proposition has more chances of being true, but seen through our biased mental lens, more detailed and specific propositions seem more probable.

This heuristic pattern has probably evolved with time because it is usually considered harder to make up specific details than general ones, so looking for these extra specificities was a good way to assess the veracity of someone’s claims.

Interestingly, Hertwig and Gigerenzer (1999) disagree: They hold that violation of the conjunction rule is not irrational. Rather than a mere classroom / laboratory experiment, the Linda problem is an example of “a situation in which adhering to social norms, here conversational maxims, is rational, although it conflicts with classical rationality,” which is defined as “adherence to the laws of probability theory and logic.” Indeed, the critics claim that “[t]he

conjunction rule is [not] the only rule of internal consistency used as a benchmark of sound reasoning.” Instead, real behavior amidst social reality does not necessarily respond to probabilistic reasoning. Rather, it is more likely responsive to prevailing social norms of conversation.

The Affect Heuristic

Affect is our internal sense of emotion – what we feel; our mood. Relying on affect involves choosing one option over another based on their anticipated effect on our emotional state.

Consider the task of choosing to vacation in a beachfront resort or in a mountain cabin. You are not given any objective criteria; both are good options. You close your eyes and ponder: serenity, ocean breezes, umbrella drinks, feeling calm versus crisp, cool mountain air; shivering all day and all night. You choose the beach. It’s a great vacation.

When we use the affect heuristic we are simulating our future self and what we will feel after we have made our decision. To the degree that our simulations are accurate we can examine our feelings before we live them. If I choose the beach I will feel serene and joyful; were I to choose mountains, I would feel cold and regretful. All animals can predict the hedonic consequences of events they’ve experienced before. But humans can predict the hedonic consequences of events they’ve never experienced by simulating those events in their minds.

“... we can close our eyes, imagine these events, and pre-experience their hedonic consequences in the here and now.” (Gilbert & Wilson, 2007)

Simulations are powerful tools for making good decisions. Antonio Damasio has advanced a very powerful thesis known as the Somatic Marker Hypothesis (SMH). The SMH proposes a

mechanism by which emotional processes can guide (or bias) decision-making.

Our brains store representations of our feelings and our associated body states: these are somatic markers. Somatic markers are thought to be processed in the ventromedial prefrontal cortex. This is the part of the brain that processes risk and fear. It also plays a role in the inhibition of emotional responses.

While walking at night down an unfamiliar street in an unfamiliar part of town, our brains store the heightened sense of vigilance and pumping heartbeat, the sense of alertness that accompanies risky situations. The next time we are in a comparable situation, our brain can bring to mind the stored somatic marker. We can simulate that feeling of taking that risk without even taking a step in the alley.

We process all this automatically; simulations are a fast process. The affect heuristic leads to good choices. We can anticipate and avoid decisions that would make us unhappy, regretful, or angry. It fails – however, when negative consequences of our decisions are particularly easy to bring to mind. When we overestimate our short-term mood at the expense of long-term satisfaction.

We often procrastinate when faced with unpleasant and undesirable but necessary courses of action, like selling a stock in which we have lost money. We do so because we are influenced too much by the short-term pain of taking action.

The Fundamental Attribution Heuristic

When we read about accidents, a common reaction is to attribute the victim's behavior to their abilities, intentions, personalities, or motives. This type of response is sufficiently widespread across all cultures that it has become known as the fundamental attribution error. It is considered an error because, when judging individuals that are placed in an identical situation, they attribute their own behavior not to their disposition, but to their circumstances. The result is that we tend to blame others for the accidents that befall them, rather than seeking to understand the cognitive traps that fooled them (and might fool us) into making a mistake. Put differently, we tend to attribute people's behavior to their core character rather than to their situation.

Closely related to the fundamental attribution error is the tendency to interpret other's ambiguous behavior as hostile. This describes the everyday experience of encountering people who don't treat you as you believe you should be treated. The feeling we have of being disrespected is so common that we talk of being "dissed." Someone says something that you feel dismisses you or humiliates you, or they ignore you, or talk about food when you want to talk about cars. You feel irritation, even anger, and ascribe ill will to your counterparty.

Most people are good and decent, subject to the same difficulties in life as you are. When they ignore us, or don't say thank you when we hold a door open for them, or step on our feet and don't apologize, or make nasty comments, we must remember that they are simply fellow sufferers.

Conclusions

Heuristics are not weaknesses. They are not failures of our decision-making. To the contrary, they are tools that help us make good decisions most of the time. Again, context matters. The key is to use the right tool in the right situation.

Each of the heuristics discussed in this chapter works better in some situations over others. The availability heuristic – sometimes referred to as the familiarity heuristic – works when we have limited information; but can be counterproductive when we have more detailed knowledge. Anchoring works best when past events are good predictors of the future. It can bias our judgments when the past isn't like today.

The representativeness heuristic is useful when thinking of common or everyday categories but less useful when confronting uncommon or atypical categories.

The affect heuristic works well when our decisions have meaningful emotional consequences but not as well when the emotional consequences are too salient or too fleeting.

Heuristics perform best when we are confronted with a decision about natural real-world events – particularly those for which we have prior experience. For instance, using a heuristic to choose a restaurant works. You have lots of experience. Past experience is a good guide. On the other hand, using heuristics to choose stocks for a retirement account may not be so successful.

Readings

Daniel Kahneman, Thinking, Fast and Slow (New York: Farrar, Straus and Giroux, 2013).

Michael Shermer, The Mind of The Market (NY: Henry Holt, 2008).

LECTURE X: EVIDENCE AND REVISING BELIEFS IN LIGHT OF NEW INFORMATION

We wanted flying cars, instead we got 140 characters.
Peter Thiel

Financial modeling, sports analytics, risk assessments, economic forecasting, weather forecasting, among others, can serve up sound analysis, forecasts, and predictions based on statistical models in no small part because they have access to copious historical data. If one assumes that the past is prologue, then it is not that difficult to construct fairly reliable models to infer future outcomes or future performance. More precisely, there is a random process generating the observed data, one that is ongoing and consistent. And, it is this random process that one can model.

However, in managerial decision-making one routinely confronts situations in which there is no persistent random process: We have qualitative data, or scant data, or textual reports, or learned commentary, or gossip, or intelligence reports, or all-of-the-above in combination with our own individual experience. All can, and do, have a bearing on our decisions. In fact, *directly relevant* empirical data is rarely available for specific, real-world concerns.

What is common to the range of subjective factors above is that they are often all that we have given the paucity of data on the particular event, or test, or product launch we are considering. When all we have is this type of data we typically resort to gut, instinct or some similar guesstimating or back-of-the-envelope decision-making. It is a fraught process. One that surely fails to use all information or selects our preferred information.

In this chapter, we learn to rely on Bayes Rule and Bayesian decision-making, a rigorous approach to quantifying uncertainty by enabling us to combine data with expert judgment.

Derivation of Bayes' Theorem

Consider that you go for your annual prostate or breast exam, as the case might be. The doctor gives you “the test.” It comes back positive (+). The doctor reports that the test has an 80 percent sensitivity. In other words, it successfully detects the presence of prostate cancer (“Cancer” or “Disease”), if you have the disease, 80% of the time.

You are totally bummed: 80 percent!!! You are bummed because you confuse the sensitivity of the test – which *assumes* you have the disease – with the actual likelihood of having cancer. You actually thought that prostate cancer was relatively rare (like less than 5 percent or so). Until you realize the following: I don’t want to know whether I test positive if I have the disease!!! I want to know whether I have the disease if I test positive!! This is powerful insight but few of us think the situation through clearly.

Ok, it’s not as altogether clear; but only at the outset. What if you *don’t* have the disease? What are the chances that the doctor or the lab or somebody messed up and you are looking at a false positive? What does this mean for it all? Actually, the false positive rate is very useful. And it is one of the three pieces of the puzzle that you need to get your answer. Again, an answer to the following question: Given that you tested positive, do you have cancer?

And again, rephrasing, what you have to know is that it is possible to establish the-probability-that-you-have-a-disease-given-that-you-have-tested-positive from the probability-that-you-would-test-positive-if-you-had-the-disease.

Suppose we look up in Google that the incidence of prostate cancer is 1 percent. We know that the sensitivity of the test is 80 percent. Sensitivity is the likelihood that the test is going to return positive given that the person *has* cancer.

We only need to know the likelihood of false positives. The false positive rate is the likelihood that the test will return positive given that the person *does not* have cancer. We look up in the back of the test machine where the manufacturer printed it and find that the true negative rate is 92.2 percent (this is known as the specificity). Thus, if the test will ding negative 92.2 percent of the time, it will ding 100 - 92.2 or 7.8 percent by mistake. And that is the number we need: The counterfactual, the false positive.

So, what do we do with this information? Stick with us, here. It has to be true that if there are flawed cancer tests (and they all are “flawed” in the sense that they report false positives) then it has to be true that:

$$P(+) = P(+|Cancer)P(Cancer) + P(+|no\ Cancer)$$

Which recognizes that positive tests result from people with cancer *and* from people without cancer.

In addition, we know from probability theory that:

$$P(Cancer|+)P(+) = P(+|Cancer)P(Cancer)$$

Which rearranges to:

$$P(Cancer|+) = \frac{P(+|Cancer)P(Cancer)}{P(+)}$$

And if we substitute for P(+|Cancer) from above we get – Bayes Theorem – which enables us to improve or update our prior likelihood of cancer with the new information available. We use the line over a word to mean negation. So, Disease means no disease or absence of disease.

Thus,

$$\Pr(\text{Disease}|+) =$$

$$\frac{\Pr(+|\text{Disease})\Pr(\text{Disease})}{\Pr(+|\text{Disease})\Pr(\text{Disease}) + \Pr(+|\overline{\text{Disease}})\Pr(\overline{\text{Disease}})}$$

where:

- $\Pr(\text{Disease}|+) =$ Chance of having Cancer *given* a positive test (+). This is what we want to know: How likely is it to have cancer with a positive result? In our case – the calculation follows - it will be 9.4 percent.
- $\Pr(+|\text{Disease}) =$ Chance of a positive test (+) given that you had cancer (Cancer). This is the chance of a true positive, 80 percent in our case.
- $\Pr(\text{Disease}) =$ Prior chance of having cancer (1%).
- $\Pr(\overline{\text{Disease}}) =$ Prior chance of not having cancer (99%).
- $\Pr(+|\overline{\text{Disease}}) =$ Chance of a positive test (+) given that you didn't have cancer. This is a false positive, 7.8% in our case, which we found on the back of the machine, as described above.

Here, then, is the appropriate calculation:

$$\Pr(\text{Disease}|+) =$$

$$\frac{\Pr(+|\text{Disease})\Pr(\text{Disease})}{\Pr(+|\text{Disease})\Pr(\text{Disease}) + \Pr(+|\overline{\text{Disease}})\Pr(\overline{\text{Disease}})}$$

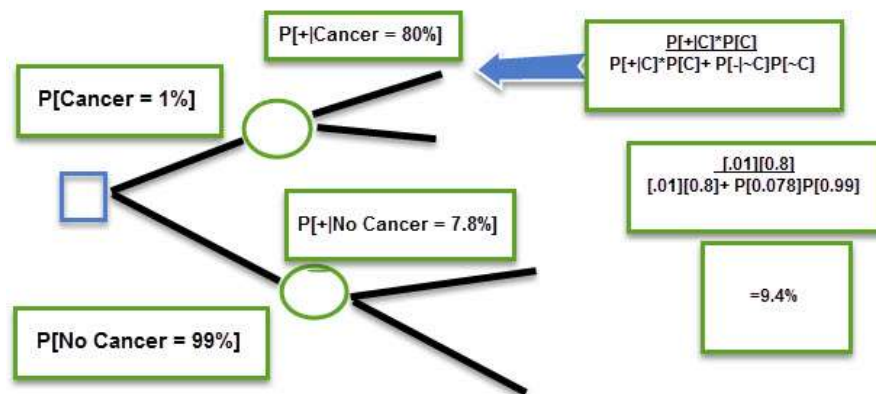
$$\frac{.80 * .01}{(.80 * .01) + (.78 * .99)}$$

$$\frac{.008}{(.008) + (.077)}$$

$$\frac{.008}{.085}$$

$$\text{Pr}(\text{Disease}|+) = .094$$

Here is a sketch that enables you to visualize the role (and relevance) of the counterfactual (that you can have a false negative test):



Whereas, before that fateful day at the clinic the chance of getting prostate cancer was 1 percent, after the test, we have to increase that appraisal to 9.4 percent. Certainly not the 80 percent likelihood that the doctor implied by referring to the quality (sensitivity) of the testing machine.

Natural Bayesians and All That

It may not seem apparent but we routinely process information as Bayesians. Indeed, our most mundane and often perplexing behavior makes sense once we scrutinize it with Bayesian eyeglasses.

We spoke about the fundamental reliance on trust to overcome the prisoner's dilemma. We must have trust to engage in mutually beneficial exchange. And we *want* to engage in mutually beneficial exchange. So, it is to be expected that the traits, customs, practices and norms that enhance, foster, and cultivate exchange were selected and institutionalized. They are baked into the decision-making process we are about to consider.

The process is iterative: the tests and filters that we rely upon are deployed to update the prior impression we have on someone's trustworthiness.

We typically form a first impression of someone by drawing on the categories and associated attributes offered up by our mental schemas. This is our prior. Thus, suppose we are interested in hiring a new instructor to teach Introductory Macroeconomics. We form a first impression from reading his résumé – good school, good degree, excellent experience, a couple of publications. Should work. I invite him in for a talk/interview.

When we then first *see* that person heading our way, we immediately – objectively or subjectively – detect that he dressed in New England suburban casual, sports a nice haircut, bears no ponytail or studs, etc. – a solid “business school look.” We therefore, revise upwards our prior, via Bayes. The “tests” triggered every correct positive reaction, and the counterfactuals were not that clear.

Then we do, in fact, meet. He extends a firm handshake and makes eye contact, again ranking high and, via Bayes again, we update our positive impression even further.

We chat. The potential instructor speaks unaccented [to a northeasterner] English, tells us he prefers the Rolling Stones to the Ramones, he's travelled abroad, speaks a little French, likes Real Madrid, and tilts socially liberal and fiscally conservative. Ding, ding, ding, ding – uncovering all that information is critical. And, updating our prior is what Bayes' Theorem is all about. When the process comes to a conclusion it informs my decision to hire this person.

Let's break it all down. By his very nature, an untrustworthy individual can easily conceal or disguise his true self – or misrepresent himself as a trustworthy person. In game theory parlance, it can be relatively costless to signal trustworthiness. The costs attached to each party's action may not be identical or even unknown to the other party. Thus, it is because of the potential of incurring a false negative or a false positive that we rely on this Bayesian adjustment. Or, put differently, we are naturally Bayesians in incorporating new information. It is a false negative if you accept the positively-appealing “firm handshake” of an untrustworthy individual. And conversely, you have incurred a false positive if you dismiss the “firm handshake” of a trustworthy individual. Obviously, “firm handshake” can be substituted for any action or test that conveys new information on the matter under scrutiny – in this case, trustworthiness.

How did a firm handshake, eye contact, the image associated with the clothes we wear and so on become institutionalized? That is to say, how did they derive the power to act as “tests” to distinguish a person's level of “trustworthiness?”

Recall from our understanding of evolutionary theory that these tests became accepted because they were life-preserving and life-extending. Consider the grimace we form with our faces when we get a whiff of rank milk. Most of us choose not to drink from that bottle of milk once the smell hits us.

The whiff is a signal that informs us about the soundness of the milk. As with all signals that categorize, two things can go wrong. Despite the pungent whiff, the milk could be good, and you end up not drinking it – pouring it down the sink and wasting a perfectly good

source of protein. This is a false positive. (milk sound = positive; refusing it = false)

On the other hand, the milk could be spoiled but you choose to drink it anyway. And you become violently sick. This is a false negative. (milk bad = negative; drinking it = false).

The kicker here is that the costs associated with these two errors are not the same. Drinking or eating putrid food in yesteryear killed people. Whereas mistakenly not eating good food merely resulted in the loss of a bit of precious food.

Thus, over time, those individuals that developed the ability to sniff out rank foods prevailed, and those who didn't – well, they died out. So, the trait – ability to detect rank foods – conferred, in the language of Darwin, an advantage in human evolution.

And so it is with any number of our heuristics. They emerged – and became institutionalized – because they were life-preserving or life-extending.

And this is the case with mores, customs and behaviors. They were singled out and preserved because they enhance something beneficial to us – like trade.

EXAMPLE 1: The Underwear Conundrum

Suppose you were living with your partner and come home from a business trip to discover a strange pair of underwear in your dresser drawer. You wonder: is your partner cheating on you?

The *event* in this situation is the following: you found the underwear. The *hypothesis*: are you being cheated?

The answer to this sort of question requires you to understand the counterfactual. In other words, how likely would it be to find strange underwear in your dresser drawer if your partner were NOT cheating on you.

But, more specifically, if we are to put pencil to paper, you have to know, or be willing to estimate, three things:

- The probability of the underwear appearing if you are being cheated.

Answer: Let's say that the probability of the underwear appearing – given that he is cheating – is 50 percent.

- The probability of the underwear appearing if you are NOT being cheated. Assume that this is the only alternative.

Answer: after mulling many scenarios you conclude that the probability of the underwear appearing could be 5 percent. An explanation could be a mix-up at the laundromat or a friend of yours forgot it.

- And here is a key element of the analysis. You need to be able to provide a prior probability (or simply, a prior) of your partner cheating. In other words, what is the probability that your partner was cheating *prior* to you finding the piece of underwear.

Answer: studies have found, for instance, that about 4 percent of married partners cheat on their spouses on any given year. So, 4 percent could be your prior.

So, to fix ideas, what you are now doing in this underwear episode is updating the probability that your partner is cheating on you by examining the piece of evidence. In other words: WHAT IS THE PROBABILITY THAT YOUR PARTNER IS CHEATING GIVEN THAT YOU FOUND THE UNDERWEAR?

Once you have estimated these three values, you can use Bayes theorem to establish a *posterior probability* – the updated appraisal of your partner cheating.

$$\text{Posterior probability} = (U|C)(\text{Prior}) / [(U|C)\text{Prior} + (U|\hat{C})(1-\text{Prior})]$$

Where $U|C$ is just point number 1 above, the chances that underwear appears given that your partner is cheating. And,

asymmetrically, $U|\hat{C}$ is the chances that underwear appears given that your partner is NOT cheating.

Note that an important takeaway – if not the most important one – of Bayesian updating is that it forces you to confront the fact that there could be an alternative explanation of the event that you witnessed. What follows is a simple representation of the logic of Bayes' Theorem.

Prior Probability

How likely is that your partner is cheating?	x	4%
--	---	----

Event Occurs: Underwear found

Probability of underwear appearing given that your partner IS cheating	y	50%
--	---	-----

Probability of underwear appearing given that your partner IS NOT cheating	z	5%
--	---	----

Posterior Probability

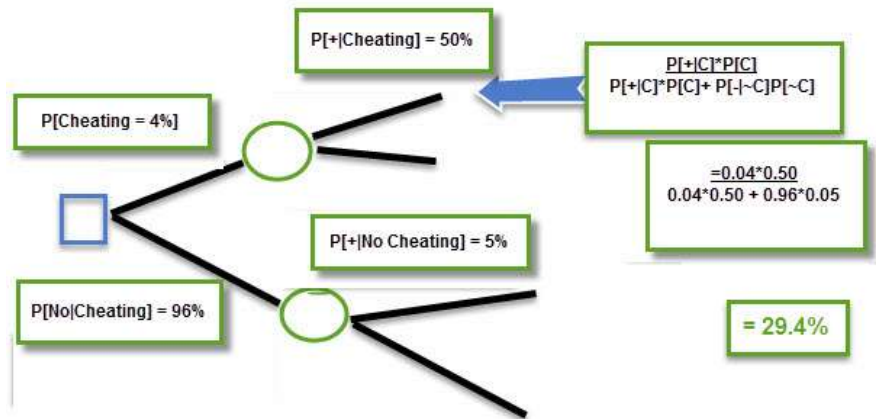
Revised estimate of how likely your partner is cheating on you	$xy/(xy+z(1-x))$	29%
--	------------------	-----

$$xy = (.04)(0.5) = 0.02$$

$$xy+z(1-x) = (0.04)(0.5) + (0.05)(1-0.5) = 0.02 + 0.048 = .068$$

$$xy/[xy+z(1-x)] = 0.294 = 29.4\%$$

The second approach is to use a decision tree to visually represent the outcomes and all relevant data.



EXAMPLE No. 2: (For you to complete)

So, what is the Connecticut Consumer Sentiment Index good for?

You take a look at this month's sentiment index and you see that it is positive. (the Event; the data) You wonder whether the economy is turning upwards. (Prior Hypothesis)



Prior Probability

How likely is it that the economy is turning up?

x

45%

Event Occurs: Sentiment Index UP

Probability of Index up if economy is up

y

55%

Probability of Index up if economy IS NOT up

z

10%

Posterior Probability

Revised estimate of how likely the economy is up

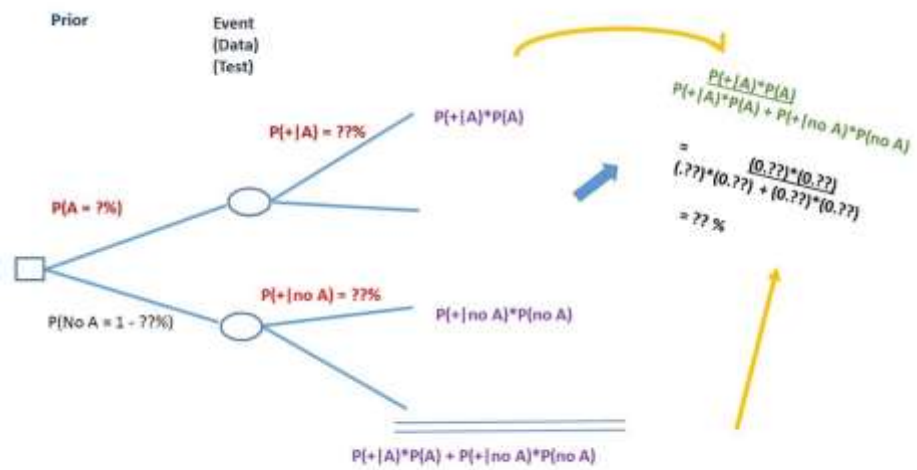
 $xy/(xy+z(1-x))$

??%

$$xy = (\quad)(\quad) =$$

$$xy+z(1-x) = (\quad)(\quad) + (\quad)(1- \quad) = ??? + (\quad) =$$

$$xy/[xy+z(1-x)] = (\quad) = \quad \%$$



EXAMPLE 3: (for you to complete)

Your roommate the druggie

A purveyor of medical devices claims they have a test that identifies 90 percent of consumer (illegal) drugs. Your roommate gets dinged in one of these tests. How likely is it that your roommate is a druggie?

Prior Probability

How likely is it that your roommate is a druggie? x

Event Occurs: Test is Positive

Probability of test positive if your roommate IS a druggie y

Probability of test positive if your roommate IS NOT a druggie z

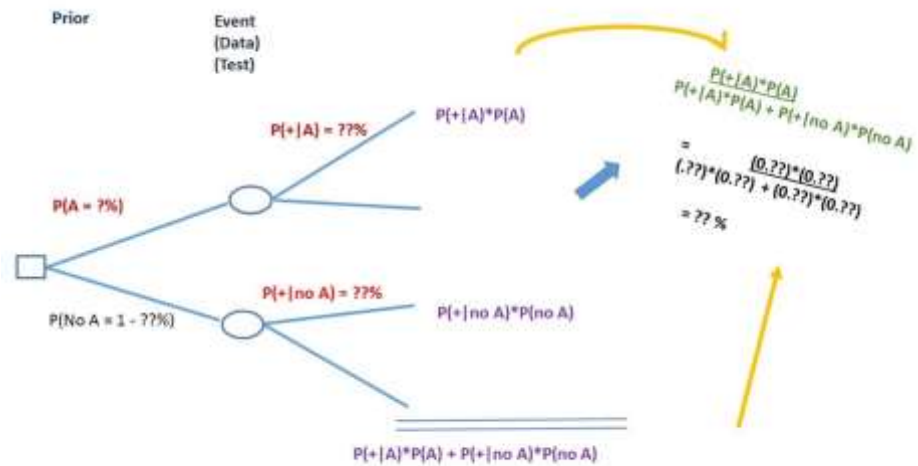
Posterior Probability

Revised estimate of how likely your roommate is a druggie $xy/(xy+z(1-x))$???%

$$xy = () () =$$

$$xy+z(1-x) = () () + () (1-) = ??? + () =$$

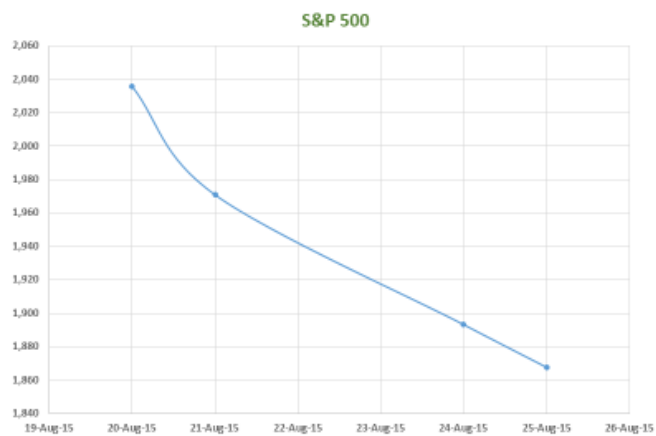
$$xy/[xy+z(1-x)] = () = \%$$



Example 4: (for you to complete)

The August 2015 Market Panic

You see the market dropping for three days in the row. You



wonder: is the economy collapsing?

Prior Probability

How likely is it that the economy is collapsing? x

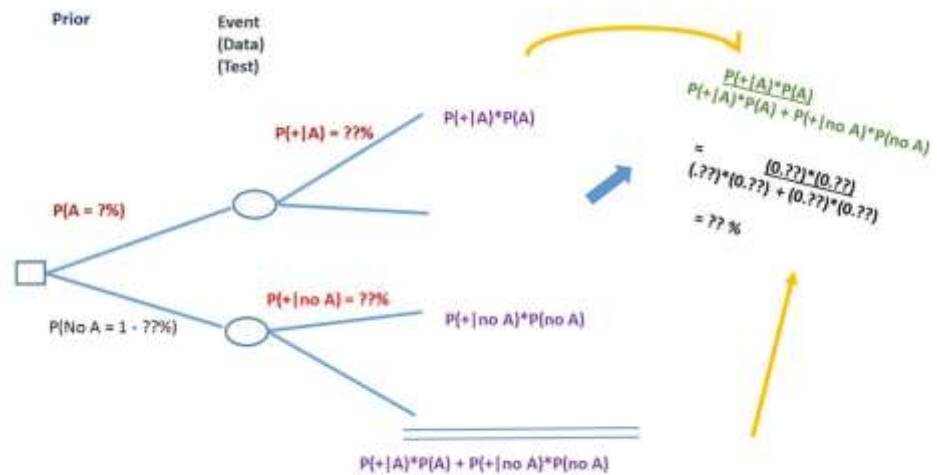
Event Occurs: Market drops precipitously

Probability of market dropping if market IS collapsing y

Probability of market dropping if market IS NOT collapsing z

Posterior Probability

Revised estimate of how likely is it that the economy is collapsing. $xy/(xy+z(1-x))$??%



Concluding Comments

The chapter should serve up three takeaways, at the very least.

- Never, never, never use deterministic sentences: all answers are probabilistic. In fact, the whole world is probabilistic. Think in terms of odds or probabilities.
- Understand the counterfactual.
- Think about priors. And if you don't know assume 50 percent. The good thing is that you can continue seeking information and relying on Bayes' Theorem to update as you go along. And the posterior from the first iteration becomes the prior in the second iteration. And so on.

Readings

Dennis V. Lindley, Understanding Uncertainty (NY: Wiley, 2006).

LECTURE XI: SOCIAL INFLUENCES & NETWORKS

"The success of any kind of social epidemic is heavily dependent on the involvement of people with a particular and rare set of social gifts."

Malcolm Gladwell, The Tipping Point (2000)

In a previous lecture on the *Peltzman effect* and financial regulation we implicitly recognized that social influences circumscribing an event – or, “context” as we have been calling it – inevitably have a bearing on our decisions about money, risk, or investing. More generally, the structure of the interactions, the social network architecture matters a great deal in structuring the impact of communications and other social events. This is commonly understood: George Katona showed some 35 years ago that most people choose investments based on word-of-mouth recommendations from their friends and neighbors. But how does this commonly understood phenomena work?

To begin the explanation of the relevance of social networks consider the following archetype. During the Spring 2016 semester, a particularly exasperating YouTube meme made the rounds to the point where several students brought it to Professor Rodriguez’s attention in class. *Damn Daniel*: a short video featuring a high school kid sporting white tennis shoes known as Vans had a meteoric 8 million plus views within a few days. The video was amazingly inane; *Damn Daniel* quickly engendered a number of equally meteoric *I hate Damn Daniel* videos. And the video clip containing the “explanation” behind the producing of *Damn Daniel* furnished by its creators, offered on ellentube, itself garnered over 13 million views on YouTube. And then it quickly died.

What is a meme? In his famous 1976 opus, *The Selfish Gene*, Richard Dawkins argued that the method or process of cultural information transmission broadly resembled genetic transmissions. He introduced the concept of a meme to represent an idea, behavior,

or style. In this sense, memes self-replicate, mutate and respond to selective pressures. Thus, memes are imperfectly replicated in the transmission from one person to another. And of course, they are not limited to YouTube, but found across all media, speech, gestures and rituals. The interaction of genes and culture has been of vital importance in providing the foundation for the rapid evolution of human traits. It is the scaffolding holding up speech and language, account for the development of morality, and the evolution of a wide range of social emotions including, jealousy, pride, shame, empathy, and guilt.

So, it is our task to explain how these memes lead to herd behavior and fashions and fads. The latter represent rises and falls in the popularity of an innovation that have little or no connection to its actual value – like Damn Daniel. It is our task explain how the inter-relatedness of assets, financial agents, and financial institutions is at the root of the effects we have discussed.

A few years ago, the Economics students at the University of New Haven created what has come to be known as the UNH Economics Collective. On occasion some student will, with absolutely no guile, ask about the Collective – generally along the lines of “what is it for?” The fact is, it’s an ongoing social experiment. But the answer that is given is that we developed and periodically publish a sentiment gauge of our stakeholder interest, a live teaching bulletin-board, and a means to connect students today with our alumni. And so forth. It doesn’t register. You can easily see what they are thinking and – politely – not saying: By comparison to social media vehicles such as Facebook or Twitter, we don’t even show up at the starting line.

James Surowiecki, in his book, *The Wisdom of Crowds*, argued that that by tapping the power of social media and in creating goal-specific discussion forums etc., substantial social capital can be built. In forums such as these – the UNH Economics Collective being one of them – people from diverse backgrounds and opinions can bring to table “shrewd judgments and creative solutions.” The managers and users of the site, like the faculty, would assist the

process by setting up mechanisms to collect and assimilate feedbacks, inputs and opinions. And we do: Students are told to post their work and collectively we evaluate them – again, publicly. Thus, the benefits, the collective intelligence of the community is harnessed, leaving us all with enhanced social capital.

There is learning in parsing the concept of *Collective Intelligence*. Amalio Rey explains that there is a difference between *Collected CI* and *Collaborative CI*. In the case of Collected CI, the takeaways are emergent properties of the sum and combination of independent acts. The UNH Economics Collective assembles the information and data that is later aggregated and analyzed by volunteer students and faculty. In a Collected CI vehicle, properly deployed, there is no direct social, nor conscious, interaction among individuals. The result emerges from the aggregation of individual behavior of participants acting strictly in their own self-interest.

Other examples of these systems are Amazon's recommendation system and Google's search engine. In both cases there is "collective aggregation." The metadata of thousands or millions of users is processed to generate a product recommendation or rank the links to some content or other. In this case the medium by which people contribute is tech-based. We only need to have a way of aggregating individual contributions. In the case of Amazon and Google – the external aggregators – they use statistical algorithms. The "Crowd" hands the data over, and the external agent (Amazon, Google, Facebook, etc.) processes and feeds back the *collective* results that individuals will then use.

"Independence" of the individual is a pre-requisite in order to obtain Collected CI, as Surowiecki and Scott Page explain. Thus, we can guarantee there will no mutual influence, and that effect of statistical aggregation will be free of biases or manipulation if we limit or curtail individual's direct interaction. Here individuals act as if there were no structure connecting them as a group, leading some authors to call these "passive" systems.

On the other hand, Collaborative CI requires deliberate and conscious collaboration among the “people.” There is intentional dialogue among individuals, leading some author to call these “active” systems.

The nature of active systems is such that individuals collaborate to obtain their personal and joint objectives. The most well-known example of this is, of course, Wikipedia. Here the know-how is created and capitalized via conscious connections, an interest in sharing, giving, receiving, and socializing. The aggregating medium’s task is to emphasize and reinforce the social aspects of these conscious links.

To understand the logic underscoring all three examples requires us to first explain the nature of social networks. Networks are the artifact that allows individuals to influence each other’s ideas, understanding, and, subsequently, their behavior and decisions. Networks, in fact, are aggregators and transmitters of information that influence population-wide, collective outcomes.

Networks

The value of many products available today is a function of how many consumers use it. The appeal of telephone service, fax machines, email, Facebook (MySpace anyone?), or, perhaps more relevant today, an app featuring interconnectedness (such as WhatsApp) depends on the number of other people hooked up to it. The underlying characteristics of all these products is that they constitute a network and their functioning is studied in what is generally known as *network economies*.

The concept of networks as an analytical tool can be deployed beyond fax machines and apps. A valuable part of the experience of watching a movie, or a television series, is being able to engage others who have also read or watched the same program. And in these

instances, small differences in the early stages of the offering can prove decisive.

I am more likely to go watch a movie at the theater if someone recommends it. Whether the film editor of the University of New Haven student newspaper reviews a movie depends on whether the movie has been reviewed in the *New York Times*.

When people are connected by a network such as Facebook or Twitter, it becomes possible for them to influence each other's ideas and understanding, and subsequently their behavior and decisions. Networks, in fact, are aggregators and transmitters of information that influence population-wide, collective outcomes.

In *The Tipping Point*, Malcolm Gladwell explains how small changes can have a large effect on determining whether a new product succeeds or fails in the marketplace. But all networks are not built the same: The social network *structure*, or architecture, matters a great deal to the outcome of a particular piece of information. For instance, networks vary to the extent that geographical co-location and shared interests are determinative.

One might think that the massive and pervasive interconnectedness of our times would overcome any advantages to co-location. One would be wrong. Perhaps for evolutionary reasons, humans prefer face-to-face interactions. Humans, as a species, engage in interaction rituals, practices from which our language, culture, motivations, social norms, and mores emerge.

The Elements of a Network

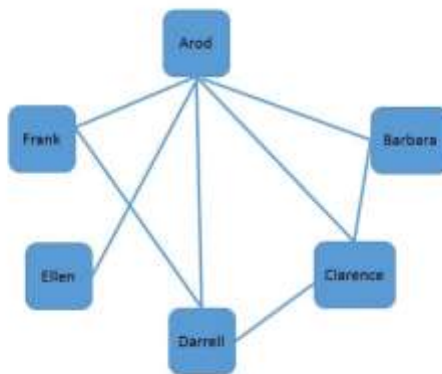
A network consists of points or nodes usually joined or linked to other nodes via arcs. Thus, you and the other members of your Facebook network are nodes. A link exists between two nodes if you are friends on Facebook; a system that is represented as an arc connecting two dots.

How important is a particular node? Indeed, in the narrative of *The Tipping Point*, important nodes played a key role in the success of marketing initiatives. There are three key metrics used to gauge importance in the analysis of networks:

- Degree Centrality
- Closeness Centrality
- Betweenness Centrality

Degree Centrality

The degree centrality of a node is simply the number of nodes connected to the given node by a link; the number of edges emanating from a specific node. It is an account of a person's sociability – or the number of relationships a person has with another.



Node	Degree Centrality
Arod	5
Barbara	2
Clarence	3
Darrell	3
Ellen	1
Frank	2

Ellen's degree centrality is 1 because she is only linked to Arod. Arod, by contrast, has 5 links: a degree centrality of 5. Degree centrality, however, does not measure the extent to which a node's links help connect a pair of nodes.

Closeness Centrality

The importance of a node depends on how close it is to other nodes. This gauge measures the average number of steps it takes for a node to reach all other nodes.

	Arod	Barbara	Clarence	Darrell	Ellen	Frank	SUM	CENTRALITY
Arod		1	1	1	1	1	1.00	1.00
Barbara	1		1	2	2	2	1.60	0.63

Clarence	1	1		1	2	2	1.40	0.71
Darrell	1	2	1		2	1	1.40	0.71
Ellen	1	2	2	2		2	1.80	0.56
Frank	1	2	2	1	2		1.60	0.63

A node with large closeness centrality is a good position to view what happens in the network. However, closeness centrality has little to say about the power of a node to influence how information flows through the network.

Note, we wouldn't recommend trying this exercise for enjoyment. The actual calculations were defined by Bavelas (1950) as the reciprocal of the farness: Closeness centrality of a node u is the reciprocal of the sum of the shortest path distances from u to all $n-1$ other nodes. Since the sum of distances depends on the number of nodes in the graph, closeness is normalized by the sum of minimum possible distances $n-1$.

$$C(u) = \frac{n-1}{\sum_{v=1}^{n-1} d(v, u)},$$

where $d(v, u)$ is the shortest-path distance between v and u , and n is the number of nodes in the graph.

Betweenness Centrality

Betweenness centrality measures the power of a node to influence the flow of information through the network; it gauges the amount of information capable of passing through a particular node. The node that has the most impact on information spread is the one through which the greater amount of information will pass.

AROD's Betweenness Centrality

PAIRS		Shortest Path	Points
Barbara	Clarence	Barbara/Clarence	0
Barbara	Darrell	Barbara/Clarence/Darrell	0.50
		Barbara/Arod/Darrell	
Barbara	Ellen	Barbara/Arod/Ellen	1
Barbara	Frank	Barbara/Arod/Frank	0.50
		Barb/Clarence/Darrell/Frank	
Clarence	Darrell	Clarence/Darrell	0.50
		Clarence/Arod/Darrell	
Clarence	Ellen	Clarence/Arod/Ellen	1
Clarence	Frank	Clarence/Arod/Frank	0.50
		Clarence/Darrell/Frank	
Darrell	Ellen	Darrell/Arod/Ellen	1
Darrell	Frank	Darrell/Arod/Frank	1
Ellen	Frank	Ellen/Arod/Frank	1

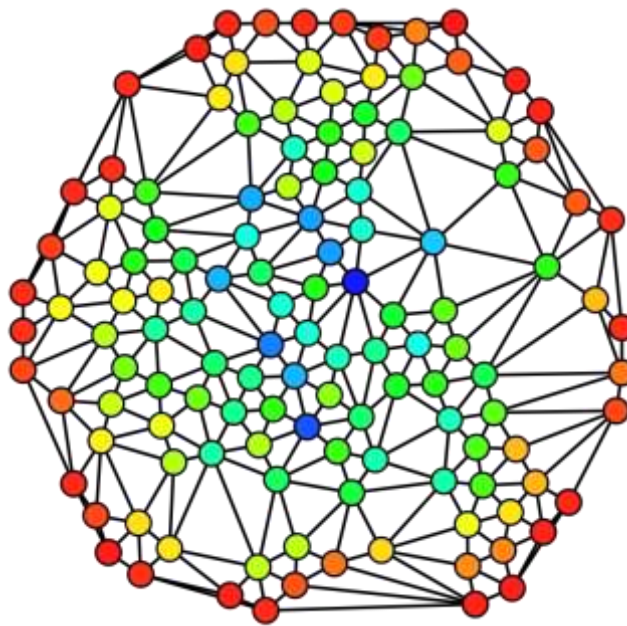
Adding the column on the far right, you can find Arod's betweenness centrality as 7.0. Depending on the other's betweenness centrality we can infer the nodes importance in spreading information.

Again, the actual calculations are complex. The betweenness can be represented as:

$$Betweenness(v) = \sum_{s \neq v \neq t \in V} \frac{\sigma_{st}(v)}{\sigma_{st}}$$

where σ_{st} is the total number of shortest paths from node s to node t and $\sigma_{st}(v)$ is the number of those paths that pass through v .

Rather than focus on the mathematics, it's easiest to view the issue of betweenness centrality graphically. In the example below, developed by Claudio Rocchini, the graph is colored based on the betweenness centrality of each vertex from least (red) to greatest (blue).



Describing Network Structures

The structure of a network can be summarized by two numbers:

- L – a measure of the average distance between network nodes

- C – a local cluster coefficient; it measures the extent to which your friends are friends of one another.

Six Degrees of Separation

In 1967 Stanley Milgram gave 296 residents of Omaha a letter posted to a name and address in Boston, MA. The idea was for each resident to get the envelope to its destiny by relying on friends. Each time the envelope was mailed was a “hop”. Of the 296 envelopes at the outset, 64 made it to the target. On average (mean), it took 5.2 hops, and never more than 10 hops. The median number of hops was 6, which gave name to the term “six degrees of separation.”

Node Pair		Length
Arod	Barbara	1
	Clarence	1
	Darrel	1
	Ellen	1
	Frank	1
Barbara	Clarence	1
	Darrell	2
	Ellen	2
	Frank	2
Clarence	Darrell	1
	Ellen	2
	Frank	2
Darrell	Ellen	2
	Frank	1
Ellen	Frank	2
count'	15	22

$L = 22/15 = 1.467$

The Milgram chain-letter episode revealed that a network of (on average) six people could be effective amidst a population of over 300 million people. This small-world effect characterizes many other types of “worlds.” For example, the world of movie acting seems impossibly huge. But it is possible to discern a network constituted by people who have worked in a movie with Kevin Bacon. In fact, in the “Kevin Bacon game” (www.oracleofbacon.org) players try to find the shortest paths in the network to Kevin Bacon.

Clustering Coefficient

A network's cluster coefficient measures the tendency of a person's friend to be friends of one another. A neighbor of node n is any node connected by a link to node n .

The Importance of Network Structures

Arod has 10 pairs friends:

Barbara-Clarence, Barbara-Darrell, Barbara-Ellen, Barbara-Frank
Clarence-Darrell, Clarence-Ellen, Clarence-Frank
Darrell-Ellen, Darrel-Frank,
Ellen-Frank.

Of these pairs of friends 3 are linked, so:

$$C_{\text{arod}} = 3/10 = 0.333$$

Barbara has 1 pair of friends: Arod-Clarence, and they are linked, so:

$$C_{\text{Barbara}} = 1/1 = 1.0$$

Clarence has 2 pairs of friends:

Darrell-Arod, Barbara-Arod and they are both linked:

$$C_{\text{Clarence}} = 2/2 = 1.0$$

Darrel has 3 pairs of friends;

Frank-Arod, Frank-Clarence, and Arod-Clarence and 2 of those are linked.

$$C_{\text{Darrell}} = 2/6 = 0.67$$

Ellen has no pairs of friends.

Frank has 1 pair of friends and they are linked.

Arod-Darrell

$$C_{\text{Frank}} = 1/1 = 1.0$$

The Cluster Coefficient of the network above is:

$$C = (0.33+1.0+1.0+0.67+1.0)/5 = 4/5 = 0.8$$

To understand and explain how social influences propagate we turn to availability and salience.

Cascades

Sometimes availability and salience spread through social bandwagons and cascades, in which apparently representative anecdotes and gripping examples move rapidly from one person to another. Unfortunately, cascades can lead people in mistaken directions, with a few 'early movers' spurring social fears that do not match reality. Why do we join cascades? Not because we have independent reasons to fear the threat but because of the fear expressed by others.

For example, the media, interest groups, and politicians are each selective in determining which risks to cover, publicize, and / or exploit. Why does the media cover certain risks and not others?

Largely because of economic self-interest. A common saying in the media business is, “If it bleeds it leads.”

Understanding the importance of media coverage, well-organized private groups work extremely hard to promote public attention to particular risks. Some of the groups are altruistic; others entirely self-interested. The common tactic is to publicize an incident that might trigger both *availability* and *salience*.

Politicians engage in the same basic project. As for people, acting as individuals, consumers, voters, etc., beliefs and orientations are a product of availability, and social influences ensure both availability and salience.

What is available is also a product of antecedent beliefs and orientations, both individual and social. Put differently, availability is endogenous to, and a product of, individual predisposition; the availability heuristic and confirmation bias operate: "the tendency to seek information to confirm our original hypothesis and beliefs."

Real Social Networks

So far, we have been examining theoretical networks. What are the elements of real social networks? Hamill and Gilbert (2009) offer some guidance.

- Social Circles: Where individuals connect to all others within a given radius, a “social space.”
- Small-world effect: Short paths between any two members of large populations.
- Searchable networks: Preference for linking to people closely related to us in interests (homophily).
- Degree centrality: The size of individual’s personal networks – their number of contacts.

- Dunbar's number: The upper limit on our brain-based cognitive capacity for distinguishing and keeping track of our friends (which is around 150).
- Clustered networks.

Readings

Timur Kuran and Cass R. Sunstein, Availability Cascades and Risk Regulation, *Stanford Law Review*, Vol 51, (1998-1999) pp: 683-768.

Jeffrey Rachlinsky, "The Limits of Social Norms," *Chicago-Kent Law Review*, Vol 74 (1998-2000) pp: 1998-1568.

LECTURE XII: HALDANES' FRISBEE: A RISK MANAGEMENT TALE

*We are ignorant of what it is we do not know even
though we know more than we can ever say.
G.L.S. Shackle*

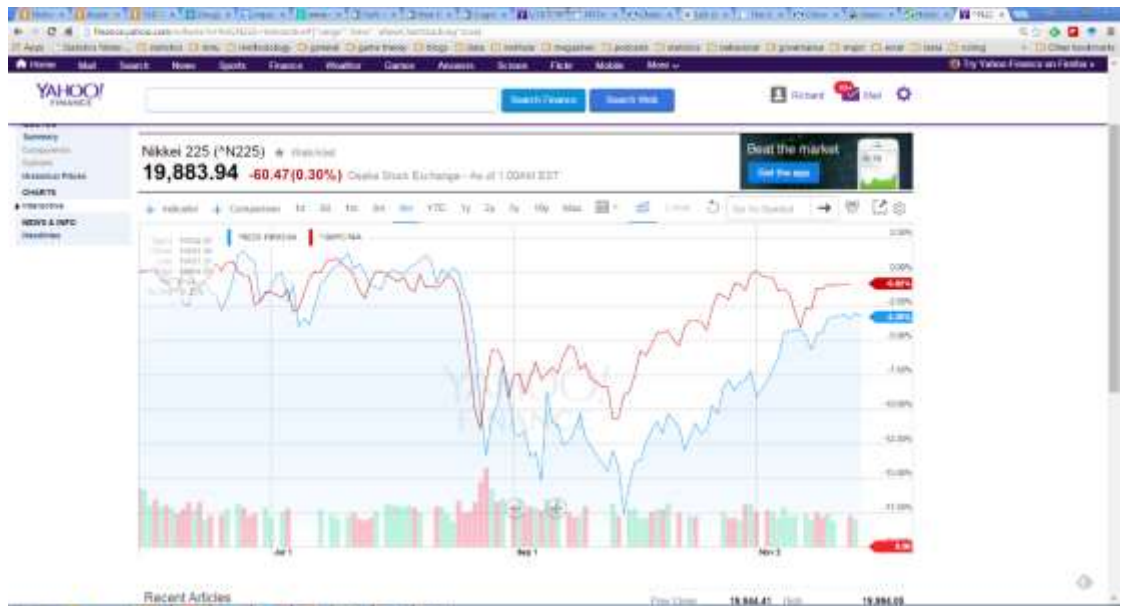
By any historical standard of pithy headlines, the August 2015 panic was certainly extraordinary. Here is how London's front-page headlines put it that Tuesday, August 26 morning: The Daily Telegraph, for instance, blared the following: "Black Monday Risks a New Financial Crisis." "Trillion wiped off markets in day of panic" (Times); "Black Monday risks a new financial crisis" (Daily Telegraph); "China urged to end market turmoil" (Guardian); "Markets take a plunge" (Independent); "Shares crisis hammers pensions" (Express) and "Global stocks sell-off as China's 'Black Monday' darkens markets" (Financial Times).¹²

And a tweet by Larry Summers, a former US Treasury Secretary and one-time candidate to take over the top job at the Federal Reserve, added to the mayhem. "As in August 1997, 1998, 2007 and 2008 we could be in the early stage of a very serious situation."¹³

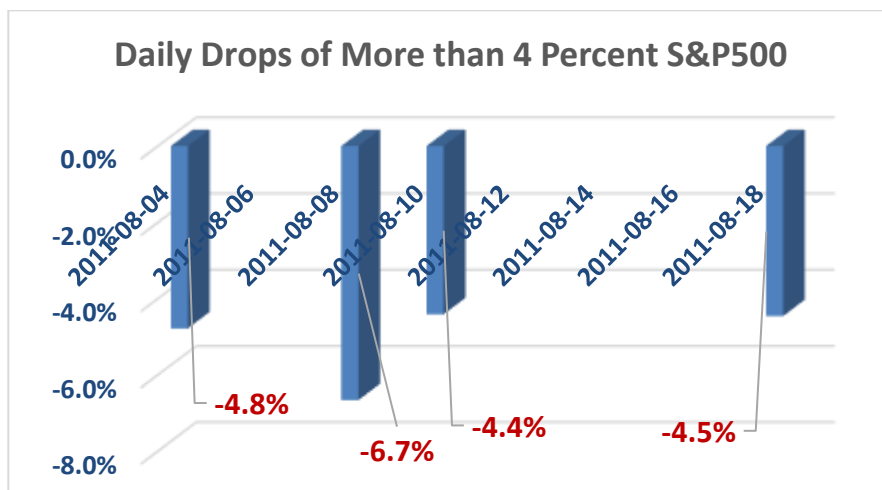
What had triggered this? On August 24 the DAX closed down 5 percent, the Nikkei 4.5 percent, the CAC 5.6 percent, the IBEX 5.7 percent and the FTSE was down 4.7 percent.

¹²Source: <http://www.theguardian.com/media/greenslade/2015/aug/25/china-stock-market-crisis-what-uk-national-newspapers-think> [viewed: December 1, 2015]

¹³Source: <http://www.telegraph.co.uk/finance/markets/11821662/Black-Monday-Stock-market-meltdown-wipes-billions-off-global-indices-as-China-fears-decimate-investors.html> [viewed December 2, 2015]



But, as it turned out, the scare which had started a plunge on Monday, August 17th had turned around by Tuesday, August 26. When it was all said and done the drop in the S&P 500 was 10.6 percent over the 6-day period. It was in fact, a significant drop; the market had not experienced such a daily drop since August 2011.



And in hindsight what was left to explore was the reason for the panic and the reason for quick abatement of the panic if that was the case. As it turns out, perhaps the lessons of the recent past were learned. With the benefit of a little Monday morning quarterbacking, it is clear what we have is an instance of heuristics leading us astray. Heuristics are decision-making shortcuts relied on by individuals especially in the face of complex circumstances characterized by uncertainty. In this instance, we can attribute the panic to our predisposition to infer patterns everywhere, even amidst randomness, combined with our need to attribute causality, even when none is evident (Kahneman, 2011).

Heuristics and Financial Risk Management

In 2009 speech commenting on the financial crisis of 2008, Andrew Haldane, with the oh-so-British title, Chief Economist and Executive Director of Monetary Analysis and Statistics at the Bank of England, attributed the failures of risk-management tools, among others, to the credit boom and subsequent bust (Haldane, 2009).

Haldane, taking a page from Behavioral Economics and Finance identified three factors: disaster myopia, network externalities, and misaligned incentives. We have just a little to say at this point about incentives and even less about network externalities (which will come at the end).

Misaligned incentives, as per Haldane, is the particular manifestation of the principal-agent problem, in which institutionally, traders and risk-managers have conflicting sets of incentives. Michael Santoro, dissecting the London Whale fiasco in the New Yorker, cited a risk manager as follows,

“The analyst who created the new VaR model said he felt ‘rushed’ and under a lot of pressure from traders.” (Santoro, 2013).

Haldane's three separate factors are interrelated. One would think that recency (the immediacy of the recent financial crisis) would strengthen the ability of risk managers to rebut or counteract any pressure from traders; and conversely, instill a sense of apprehension in traders themselves. But this time around we can only surmise about the strength of recency in the outcome of the August 2015 crisis.

We can say a little more about Disaster Myopia. Disaster myopia refers to agents' propensity to underestimate the probability of adverse outcomes, in particular small probability events from the distant past. Disaster myopia sounds very much like out of sight out of mind. In behavioral economics, the availability heuristic tells us that the more recently an event occurred, the more of an impression and influence on current decisions. By extension, the higher the subjective probability of recurrence attached to it by agents. In this instance, the farther and more distant are the memories of the last crisis – the more likely we are to throw caution to the wind.

In explaining disaster myopia Haldane hypothesized that the subjective probability after a period of approximately 10 years is effectively set to zero and a perception of safety subsequently ensues. As memories fade and a false sense of security associated with seemingly sophisticated, and therefore faultless, risk management tools emerges, the danger of devolving decision-making to the process and away from the individual judgment, increases.

Paradoxically, the outcomes associated with the adoption of regulation is offset by the decision-making complacency that sets in as a result of the false sense of security. This is, of course, an instance of the well-known Peltzman effect.

In the early 1970s, Sam Peltzman argued that mandatory safety devices such as seat belts reduced the probability of harm to the driver if the car crashed. Paradoxically, the increased sense of safety would encourage people to drive more recklessly. This would result in an increase in the accident rate and increased injuries thereby offsetting the original aim of reducing injury from accidents.

This perversion of a decision-maker's incentives is not only relevant for road safety but a generalizable argument to all forms of regulation. There are likely *Peltzman effects* in all forms of regulation. And indeed, it has been shown to be the case for financial regulation.

Consider the case of introduction of *deposit insurance programs* to reduce "risks" in the financial sector. The primary intent was for deposit insurance to reduce bank runs by assuring the public of the soundness of their deposits. While the deposit insurance scheme might reduce the incidence of bank runs it has the wholly unintended effect of making both bank owners and depositors take bigger risks. Bank owners find that their appetite for riskier ventures has increased. And depositors, in turn, would tend to prefer those now riskier banks. A riskier bank may pay higher returns alongside an increase likelihood of collapse. But any blowback to bankers and depositors is limited by the stipulated deposit insurance. The net result of the deposit insurance program could very well be – paradoxically - a net increase in sector riskiness.

Adjusting our behavior as a result of the increased sense of efficiency leads to the dark side of risk management where we adjust our behavior to perceived improvement in risk outlook. Risk management encourages unintended, offsetting risky behavior.

Consider the recent experience with the popular risk management tool known as VaR (Value at Risk). VaR is essentially a probability measurement based on historical prices of assets. It estimates the loss in value that a given portfolio could experience. For example, one might use data from 500 trailing-days to estimate how much a portfolio might decline the following day.¹⁴ (And, presumably, allow or require, a set-aside or buffer to curtail the prospective downsides of this negative eventuality.) This is far from a perfect measurement

¹⁴ Trailing refers to the most recently completed period. Thus, 500 trailing-days takes into account the last 500 days when calculating a measure, such as an average.

of risk. But it has the virtue of being simple: at the end of each day, a bank, or a regulator, can estimate how much the bank, and each of its individual portfolios, might lose over the following day, month, or some other period.

Examining Haldane's Thesis

Is Haldane correct? Is there a continuing disaster myopia and was it responsible for the August 2015 panic? We assemble the following portfolio to examine (rather like a bird's eye view) Haldane's thesis. The toy portfolio consists of equal shares S&P500 and GE (formerly, a Connecticut company!).

An asset's Value at Risk or VaR is the maximum loss of an assets value over a target horizon within a confidence interval under normal market conditions). Simply put, it is the maximum loss over a given time period, if no extreme events (low-probability events) occur (Jorion, 2006). The method we use to calculate VaR and illustrate our argument is the delta-normal method:

$$VaR = \alpha * \sigma * Exposure$$

where:

Alpha = standard normal deviation corresponding to the specific confidence level.

Sigma = the volatility of the underlying asset. In the example here, it is the historical volatility.

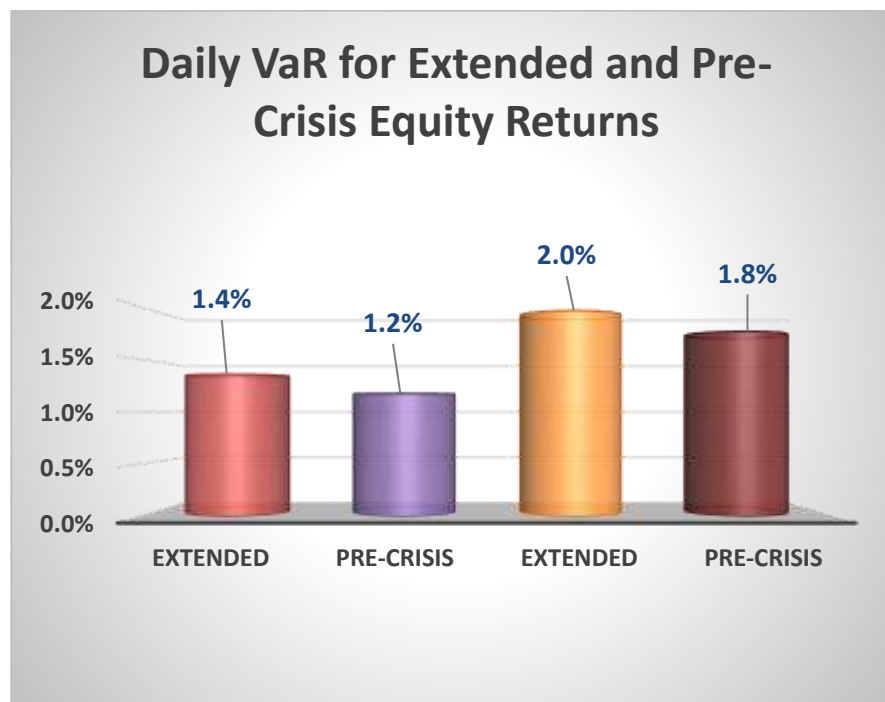
Exposure = this is the exposure to the particular risk factor; in this case the prices of the assets

If the VaR of the (undiversified) August 17th portfolio is significantly smaller than one calculated with the extended data – one

encompassing the August crisis – then we may surmise that Haldane is correct, or at least, that there is something to his argument, that myopia has set in.

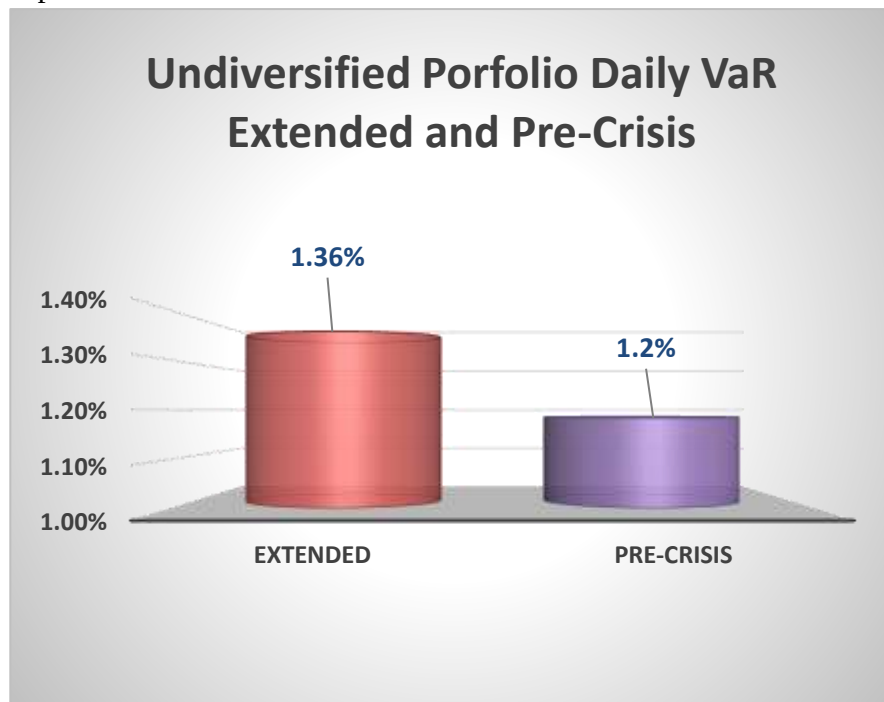
We calculate the delta-normal 1-Day VaR based on equity returns for the toy portfolio. We calculate the undiversified VaR based on 500-day equity returns up until August 14, 2015. And then extend the calculation to encompass the August 17-26, 2015 panic (up to October 30, 2015).

The graph below reflects the result of the exercise: the change in the daily VaR for each of the two components of the toy portfolio is noticeable although the realized difference may not necessarily be statistically significant.



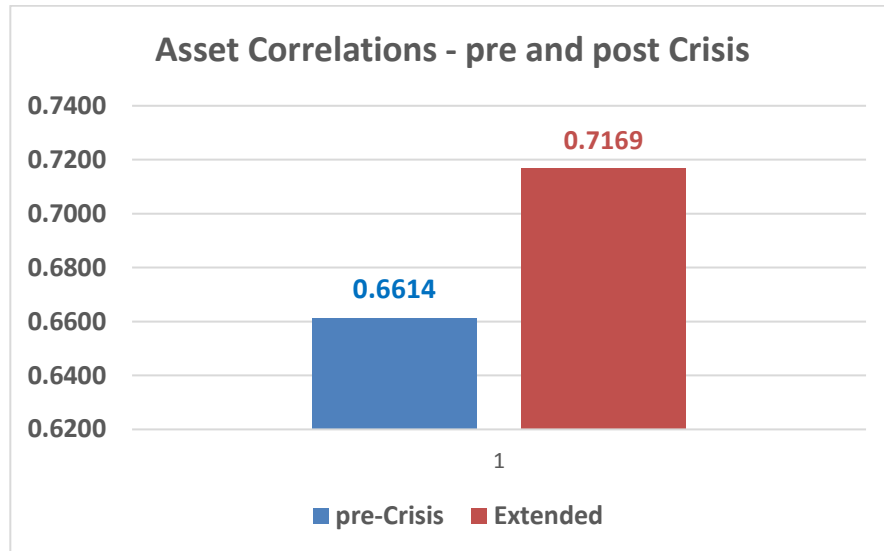
The undiversified portfolio VaR increases by approximately 15 percent once the sample is extended indicating a modest underestimation of risk. Again, the results here are much less

noticeable than the results obtained by Haldane, who found a VaR change for a sample of UK bank in the range of 60 percent. He compared the VaR results immediately before the crisis of 2007 and immediately after, his “extended” statistical set encompassing the crisis period.



Haldane explores network externalities as another root cause of the 2007 crisis. Any asset portfolio is a financial network, as is the balance sheet of a large financial institution, as is the financial network itself. The financial system is similarly a network with nodes defined by the financial institutions and links defined by the financial interconnections between these institutions.

So exogenous effects affecting some nodes are likely to spillover on the network. And in times of stress, asset correlation matrices are unlikely to be stable and correlations invariably head towards one. In fact, the asset correlation movement pre- and post-August 2015 crisis in our toy portfolio demonstrates this factoid.



Thus, if we are to draw any lesson from this little back-of-the-envelope exercise it is that it behooves us to be prudent and appraise individual VaRs conditional on other institutions in the network simultaneously facing stress: what are known as conditional VaRs.

By the Skin of our Teeth

It appears that the latest (August 2015) crisis, which seemingly caused so much panic, appeared when the memories of 2008 were still around; fresh in our collective minds. Paradoxically, whereas the relatively fresh memories of the crisis empowered risk managers, one could argue the same memory compelled a panic in the public at large. Indeed, this is to some extent the reason for the convergence of correlations.

So, all in all, it does appear that there is something to the Haldane hypothesis: that disaster myopia coupled with Peltzman complacency are recurring feature of the risk management environment. And so

we benefit the most when we refuse to abdicate judgment to empirical tools.

Concluding Comments

What we have here is not really a test of Haldane's claim – that disaster myopia, *inter alia*, was responsible for the 2007 crisis; or network externalities or misaligned incentives. In fact, it's not clear that Haldane's claim is on sound empirical footing to begin with, although there is certainly considerable circumstantial evidence that assembles into a very persuasive case.

So, what we did here is frame this lecture around those of a very insightful thinker who continues to call attention to the (over) reliance on seemingly complex tools – at the expense of experience, realism, and judgment. Haldane's is a modern-day hat-tip to Keynes, Hayek, Simon, and Friedman, all of whom placed imperfections and knowledge center-stage.

Importantly, more to the point here, Haldane's comments enable us to focus attention on VaR as a fundamental risk-management tool; but equally wise is to focus attention on systemic, and collective behavioral and decision-making pitfalls. And lastly, *“to prefer true but imperfect knowledge, even if it leaves much undetermined and unpredictable to a pretense of exact knowledge that is likely to be false”* – words of wisdom spoken in 1974 that continue to ring true (von Hayek, 1989)

Readings

Here is A. Barton Hinckle on [Habituation](#), writing in Reason Magazine.

And

<https://www.aei.org/publication/everything-is-amazing-right-now-and-nobody-is-happy-or-americans-forget-how-good-they-have-it/>

Sam Peltzman

<https://www.youtube.com/watch?v=7IB2xRfRHOA>

LECTURE XIII: VALUE-BASED DECISION-MAKING

The only thing that makes life possible is permanent, intolerable uncertainty: not knowing what comes next."

— Ursula K. Le Guin, *The Left Hand of Darkness*

In the ongoing example in class, I have been asking what attributes you would include in an AI like Ava, to ensure that she would pass the Turing test. At some point you would have to turn to choices; in other words, you would have to design a system that would instruct Ava how she should make choices. To pick one TV show over another, or a magazine over another, or a book over another, or refuse a yucky-tasking meal, – and, progressively, more complicated ones like whether to select a particular stock over another. Which political candidate, political idea should she choose. How would that system operate?

Think about how you choose things. Why do you choose a particular item at the supermarket? Snacks – potato chips or cookies, for instance. Suppose you go shopping and you leave the supermarket with a 12-pack of Doritos. Why did you choose this particular brand and size?

Every product (goods & services) constitutes a “bundle of attributes” – tangible and intangible. And you have a sense of value across all of these attributes. Knowledge of different brands – including their reputations, nutritional value, aesthetic quality of the packaging, - all converge into some internal sense of value for the product.

For conventional economics, the answer is a piece of cake. The choice comes down to a comparison between Doritos and money. These are two very different things: a veritable comparison between apples and oranges. This comparison problem is easily resolved once the comparison is framed in terms of the conventional scale: utility. Thus, at the margin the derived positive utility (pleasure) from eating

those Doritos is greater than the disutility (displeasure) of giving up money.

But this reasoning is somewhat problematic because it is seemingly tautological. In effect, what we are saying is that we chose the Doritos because the gains exceed the costs. And the prediction of what we would choose actually set forth the criteria that we would chose the product whose utility was greater than its price.

Circularity, however, is avoided by assuming that people behave consistently. Indeed, this is a foundational assumption in conventional economics: that preferences are immutable. And recall, that those preferences are consistent. Once you have revealed that you prefer A to B you should not subsequently choose B over A.

But we have seen that preferences are far from being fixed. Yet, it is worth noting that in the economics of utility we use the language of pleasure and pain – utility and disutility. We purchased the Doritos because their consumption conveys pleasure. We feel good about our decisions.

Linking value to pleasure and pain harkens back to Jeremy Bentham, in *Introduction to the Principles of Morals and Legislation* discussed the fundamental motivations of our decisions. “Nature has placed mankind under the governance of two sovereign masters, pain and pleasure....” Bentham is noting that we value what gives us pleasure and simultaneously stating that we *should* value pleasure. This thinking has served as the foundation of theories of utilitarianism.

But pleasure cannot be the only thing that matters. Even Bentham later recognized this. We do many things that are not pleasurable. What else could determine value? How about how much we benefit from something. Many of the things we value have clear direct benefits. Food provides nutrients, clothing protects us, our homes provide shelter and even our social interactions convey value in the commonality of shared experiences and friendships.

When we think in terms of evolutionary traits – we could argue that the benefits we select in the things we choose ensure our chances

of passing along our genes. The problem with the argument which holds that everything we eat is good for us is that there are, of course, numerous counterexamples. We eat chocolate chip ice-cream, consume massive amounts of gin & tonics, pork chops, and gravy. In our abundant society these are hardly beneficial, in an evolutionary sense (although they once were).

And although it is true that we value things that please us and those that benefit us, we cannot explain what we value by either pleasure or benefits alone; they often trade against each other. There are often instances where the value of the good is detached from its benefits. And importantly, these two measures are determinants of value but do not necessarily travel well. A system or algorithm coined in terms of pleasure or direct benefits would have no general applicability. We need to examine the choice process a little deeper – literally.

Consider this. You are not eating the Doritos when you purchase them at the supermarket. When we purchase something we almost never consume immediately. All the benefits, whether taste or nutrition, come later; sometimes quite a bit later. So, the process of choice must have relied on something else, some anticipation about the future pleasures to be derived; some expectation. And to anticipate or expect something we need to be able to predict outcomes and the value of outcomes, so we need to have some internal ‘simulator.’

Here is how Douglass North puts it:

[...] we form mental models to explain and interpret the environment – typically in ways relevant to some goal. Both the categories and mental models will evolve reflecting the feedback derived from new experiences: feedback that sometimes strengthens our initial category and models or may lead to modifications – in short, learning.

Your brain simulates the multiple Doritos consumption scenarios, attaches utility to each one, and uses the resulting ranking to choose. Simulations of experiences generate some kind of “signal,” which

then enables us to learn from it – specifically, from the experience it is simulating. Happy responses, or regret responses, are therefore attached to each particular simulation and the experience valuation subsequently updated.

The capacity to imagine all sorts of would-be scenarios through simulations of experience confers a distinct advantage for decision-making and planning. Note that all the simulations are conditionals. And the simulations are counterfactual experiences. They are not real experiences, but they are like real experiences, and they influence our real actions and they take up valuable processing time in our brains.

Although we resort to simulations to anticipate prospective actions and outcomes, we proceed in a manner which limits or eliminates reducible uncertainty while recognizing the presence of irreducible uncertainty. The magnitude of the latter tells us when to stop taking actions. Paul Glimcher has argued that all biological decision-makers confront two types of uncertainty: reducible and irreducible uncertainty. The former is uncertainty about the external world and can be reduced through exploration and learning. Only limited resources prevent this type of uncertainty from being completely eliminated.

Irreducible uncertainty is more interesting, especially for its effect on behavior. Glimcher tells us that Werner Heisenberg's uncertainty principle makes clear that the physical world has a quantifiable level of irreducible uncertainty that no amount of measurement or knowledge can eliminate. Glimcher's basic idea is that organisms will express irreducible uncertainty in their behavior. The driving constraint that selected for such irreducible uncertainty is the need for interacting organisms to outperform others with whom they compete or on whom they prey.

If organisms had only complicated strategies for behavior, it is conceivable that over millions of years a competitor could adapt to those strategies. Irreducible uncertainty, as a component of a behavioral strategy, cannot be learned and exploited by an opponent. Glimcher offers several concrete examples of these ideas. One take-

home message is that most complex creatures should have internal processes that are roughly equivalent to a random-number generator. This random number generator within us imputes enough irreducible uncertainty into our actions to curtail perfect simulations. True self-deception. To avoid “tells.”

Reward Prediction Error

In a fragment written in 1929 or 1930, the philosopher Walter Benjamin identified the gambler’s particular brand of ecstasy, what he termed the ‘remarkable feeling of elation’ that comes with a win. It is a feeling ‘of being rewarded by fate, of having seized control of destiny’. The gambler, in other words, is after a high.

Benjamin noted the appeal of a ‘danger factor’, which arises ‘not so much from the threat of losing as from that of not winning’. Pushed to the limit – the tiny precipice that is the gambler’s natural habitat – the threat of not winning carries with it the risk ‘of arriving “too late”, of having “missed the opportunity”’. Here lies an anxious thrill all of its own that coalesces into an intense presence of mind, which the gambler, in turn, understands as ‘divination’. Thus is born a kind of magical thinking that untethers the gambler from the world, and claims him, for as long as the game casts its spell. (Benjamin, NA)

The explanation for this elation as described by Marina Benjamin starts with recognizing neurons, specialized cells within our brain. Neurons are the information processing cells within the brain; and there are about 100 billion of them. The neurons we are interested in is in an area called the ventral tegmental area (VTA). These neurons are key to our decision-making. This neuron operates with the neurotransmitter dopamine. Neurons generate electrical signals. The rate at which neurons transmit signals is called the firing rate. Each

time an electric signal moves along these neurons it triggers the release of dopamine.

Dopamine neurons respond to a range of rewards. Dopamine neurons alter their rate of firing in a predictable manner based on the resulting outcome and the envisioned outcome.

$$\begin{aligned}\text{Dopamine Response} &= \\ &= \text{Reward Prediction Error} = \\ &= \phi(\text{Reward Occurred} - \text{Reward Predicted})\end{aligned}$$

Neurons increase their firing rate when rewards are better than expected. And they decrease their firing rate when rewards are worse than expected. And if the reward is completely predictable – as when there is advance warning that the reward would be delivered – then the firing rate does not change at all. This net difference between anticipated and actual outcome is called the *Prediction Error* or, more specifically, the *Reward Prediction Error*.

The brain creates an expectation, a prediction, a reference point, about what reward should be received at each point in time. And then it gauges the outcome against the expected outcome. And throws up signals accordingly.

It is important to clarify that dopamine neurons do not respond to the rewards themselves; rather, they respond to whether the reward was better or worse than the current, anticipated, reference point; this is the Reward Prediction Error. And importantly, dopamine neurons are not associated with experiences of pleasure, or liking, but for motivating animals – and us – to seek out rewards: what researchers call *wanting*.

As an aside, and with respect to the quote by Marina Benjamin, the disappearance of dopamine neurons is associated with Parkinson's disease. Treatment for Parkinson's entails replenishing dopamine in the brain. Among other things, the surge of dopamine treatment amplifies the unexpected changes in reward; and they could increase reward-seeking behavior. Parkinson patients are known to exhibit

uncontrollable pathological gambling – they would go to casinos and gamble – seemingly unable to stop.

Let's return to the original question: how would we construct a mechanism for enabling an AI to determine value and, thereby, to choose? We trotted out Bentham and the pleasure principle. In this world, value was derived from experienced or anticipated pleasure. But that did not quite work too well. Then, he suggested benefits; but again, it failed to apply. Key dopamine neurons are necessary neither for pleasure nor for benefit. Dopamine neurons respond by increasing their firing rate when a reward is better than our expectations. And they decrease their firing rate when a reward worse than expected. Our brain responds to new information about rewards – not necessarily to rewards themselves. Ava would need a reward prediction system.

Readings

Wolfram Schultz, "Dopamine Reward Prediction-Error Signalling: a Two-Component Response," *Nature Reviews: Neuroscience* Vol. 17, No. 3 (2016) pp 183-195. [online at: <https://dx.doi.org/10.1038%2Fnrn.2015.26>]

LECTURE XIV: REFERENCE DEPENDENCE, LOSS AVERSION & THE ENDOWMENT EFFECT

*"In the history of the world, no one ever washed a rental car."
Heard on NPR*

Suppose you walk into a store and you see a box of cereal that is being advertised at a sale of \$1 off a price of \$2.95. It would catch your eye. Conversely, \$1 off a \$79.95 is hardly worth glancing at. Yet, a dollar is a dollar. The phenomenon at work is the Weber-Fechner Law applied to pricing. And the broader concept is the concept of reference-dependence: "Context matters."

Formally, the Weber-Fechner Law can be represented as follows:

$$\Delta P/P - k > 0$$

Where k is a threshold constant that activates a "just-noticeable-difference." The expected utility model tells us what prospect we should choose. By contrast, prospect theory is a descriptive model that explains what prospect people actually choose. Prospect theory relies on two unique analytical concepts: (a) reference dependence, and, (b) probability weighting.

Conventional economics assumes that the value of money follows a pattern of diminishing marginal utility. For instance, the difference between \$0 and \$1000 seems much greater than the difference between \$100,000 and \$101,000. Marginal utility is diminished with each additional dollar you have. The notion of marginal utility reflects the subjective sense that a given amount of money – in this case \$1000 – is worth more to someone who has little than to someone who has much. It follows that utility, in classical economics, depends on absolute wealth.

But this is not how it usually feels. Most people dislike losing 1,000 – regardless of wealth. For an explanation we turn to reference dependence. We should have noted, in the marginal utility of money example, that where we start matters for purposes of determining

utility. Keenly, prospect theory proposed that people evaluate potential outcomes in terms of relative changes in wealth rather than in absolute states. When faced with a risky decision we think less of the money we have in our bank account and more about whether we will be better or worse afterward. We end up risk-averse for fear of losing money.

Reference points are common in our everyday life. Consumers love sales: prominently advertising 20 percent off regular prices will bring customers into the store. From the perspective of our diminishing bank account – we don't save money when we buy something at 20 percent off. But if the reference point is the regular price – getting something on sale seems like saving.

Consider the following analogy. Imagine you are walking at night and you see an unidentified flying object - bright against the surrounding darkness. Next imagine a similar situation – except that it occurs during a bright, shiny, day. Again, above you is a dark object in the sky; another unidentified flying object. At night your vision adapts. When you walk from a dark house into a sunny day – your eyes adjust. We all see white surfaces in starlight as white and black surfaces in sunlight as black. The black surfaces actually reflect more light into your eyes than the white surfaces. In fact, they reflect about one million times as much. And it stills looks black.

At issues is a fundamental physiological and cognitive processing problem: how can you represent information with sufficient range to accommodate big numbers, but with sufficient precision to resolve differences between small numbers. In the unidentified flying objects example, above your visual system adjusts its point of reference based on the overall brightness.

When the world is dark, the reference point decreases and tiny changes in absolute brightness increase the firing rates of neurons. When the world is bright, the reference point increases and much greater changes in absolute brightness are required to alter neuron's firing. This same principle applies to all other senses, motor systems,

and decision-making. What holds for simple sensory judgments also holds for high level judgments are goal-oriented decision-making.

Recall the relationship between dopamine neurons and a range of rewards: they change their rate of firing in a predictable manner. The brain creates an expectation, or reference point, about what reward should be received at each point in time. They increase their firing rate when a reward is better than expected. They decrease their firing rate when a reward is worse than expected. And when the reward is completely predictable – then the firing rate does not change; this we understand to be the reward prediction error hypothesis of dopamine.

Examples

Lottery ticket

Suppose you find a scratch lottery ticket. Suppose you anticipate winning \$2. Dopamine neurons start firing. If you actually scratch and win \$10 that would be better than expected and your dopamine neurons start firing faster. But if you win \$1, your dopamine neurons decrease their firing rate. Key: Dopamine neurons do not respond to the demand itself, but rather, to the whether the reward was better or worse than the reference point established.

Online poker

True fact: the poker players who won the most frequently also lost the most money, overall. Those players tended to win games involving small amounts of money, but they also tended to lose games involving large amounts of money. The players who win most often are aggressive and stay in many games, even with poor hands.

Most of the time this is a good strategy because they discourage the other players from playing and they can collect pots with relatively small amounts of money over and over. But some of the time, they'll play aggressively when they have a pretty good hand, but someone else turns out to have an even better hand. They then lose big. It begs the following question: why don't they learn from their mistakes? As

it turns out, they fail to learn because of reference dependence; dopamine neurons are sensitive to *whether* you win or lose and, to a much lesser degree, *how much* you win or lose. So, a \$10 win is coded GOOD and a \$1000 loss is coded BAD. But the bad event is not 100 times worse the good event from a utility point of view.

Loss Aversion 1

Imagine you are a television salesperson. There are two compensation plans. Selling TVs with either commission or prepayment-and-giveback. When you are paid commission, you make money based on how much you sell. Alternatively, your compensation includes a whopping pre-payment. And at the end of the year, the amount is reduced if you don't meet your quotas to match the compensation. On which compensation plan do agents sell the most? Not surprisingly, agents sell more TVs when they are prepaid.

Loss Aversion 2

Suppose the objective is to increase your personal pension contribution. Which is more likely to result in higher balance: Pension matching by company or pension contributing plus withdrawing if you don't match?

Endowment Effect and Mugs

Recall that under the endowment effect, we adjust to our level of ownership that then becomes the reference point against which we judge future gains or losses.

Suppose we show mugs to all students. We then ask those who didn't get a mug how much they would pay to purchase the mug; suppose they say \$5. This is their willingness to pay.

Suppose we gave mugs to a select group of students. How much would you be willing to accept to give up the mug? Suppose they say

\$10. This is their willingness to accept. In other words, owning the mug shifts your reference point, so that your willingness to accept price becomes greater than your willingness to pay price. This is inefficient market behavior and contradicts principles of valuation.

Salesmanship

Your prospective customer shows interest in a car on your lot but is still clearly fond of his car. How do you minimize the potential loss aversion and sell the new car? The trick is to show substitutability: many of the same qualities but emphasize a small set of positive qualities like more horsepower or improved gas mileage in the new vehicle. You want them to think of the transaction as one of upgrading not as one of selling and buying.

Other Strategies

1. Shift your reference point: You are confronted with a situation in which you have to purchase or sell something you own. Stay organized: Ask yourself, “What would I pay for this if I didn’t have it already?” This is known as “reframing the decision problem.”
2. Separate the smaller and larger consequences of a decision: When buying a car, what difference is made by a few floor mats? Ask yourself, “If I already owned this car, would I pay \$500 for floor mats?”
3. Create hypothetical alternatives for your decision. Vacation with the family this year? Fun and expensive; it is hard to know whether the benefits outweigh the costs. But think: what else could you do with the money? A different vacation? A new car? Every choice has an opportunity cost: just make it visible.

Readings

Jonathan Baron, Thinking and Deciding (NY: Cambridge University Press, 1998).

John Payne, James Bettman & Eric Johnson, The Adaptive Decision Maker (NY: Cambridge University Press, 1993)

LECTURE XV: COMMONALITY AMONG PURCHASES

*When someone wants a sheep, that proves he exists.
Antoine de Saint-Exupery, The Little Prince*

When you are confronted with the opportunity of buying either a mocha-latte or a cappuccino with a double shot of caramel, you probably deliberate about 0.007th of a second. And as to what type of refrigerator or car to purchase, you probably spend quite a bit of time and effort before you decide. The purchase of durables – cars and refrigerators – has consequences that trickle in over time; sometimes even decades, as in the case of deciding where to go to college – an investment in skills and social capital. Thus, when considering the purchase of a durable – or a college - you read consumer reports, visit web sites, dutifully do your homework. In other words, you amass considerable amounts of information before deciding.

However, once the information is assembled, you don't know how to process the information. Do you weigh pluses against negatives? A weighted average? And if so, do you ascribe stronger weights to certain variables – i.e. ease of use, durability, etc. Or do you keep them weighted equally, which is what you implicitly do when you don't directly ascribe weights.

Could you rely on heuristics to accomplish the fundamental task – to make a decision – any kind of decision? The big decision is no different from the much smaller one. The answer is yes.

Big decisions and small decisions share a common process. The same areas of the brain help you anticipate potential rewards, evaluate potential risks and compare one option to another. There is no special section of the brain devoted to big decisions and one exclusive for tiny decisions.

The same range that accommodates the firing capacity of your dopamine neurons is responsible for simple decisions – cheeseburger or siracha burger – as it does for important decisions; even life threatening ones, like whether to avoid charging at a T-Rex.

Caveat: Clearly, not all decisions are equally important. And not all decisions demand the same amount of care, consideration, and time, nor do they evoke equal emotional responses.

Big decisions are just small decisions on a different scale.

Example: 15 minutes for 5 dollars? The simple tradeoff: spend 15 minutes more to save \$5. If it seems reasonable for coffee, it should seem reasonable for the wide-screen TV. But it isn't. We give up time for money when buying coffee and give up money for time when we are buying the big screen TV. Why the inconsistency? These preferences are inconsistent.

Example: Allon, Federgruon, and Pierson (2011) calculated the trade-off between time and money when people patronize fast-food restaurants; how far were people willing to travel; how people's willingness to pay differed between different chains and locations; how long people waited in the drive-through.

Each second was worth about 4 cents. So if a fast food restaurant takes one minute longer than its peers to serve customers, it needs to be about \$2.40 cheaper in price to be competitive. 1 minute = \$2.40.

Time is extraordinarily valuable to a fast-food customers.

1second = \$0.04

1 minute = \$2

60 minutes = \$120

That is more than 10x the minimum wage (of \$10 per hour).

What is the explanation for the paradox – that sometimes time is more valuable than money and sometimes money is more valuable than time?

Consider the ranges of prices. Coffee varies over a small range; wide-screen TVs can vary by thousands of dollars. The basic principle: our sense of a meaningful difference in some quantity is inversely proportional to its range – the just noticeable difference we talked about last time.

\$5 is a big portion of the range of coffee; and a trivial portion of the range of wide-screen TVs.

Again, context matters: What matters is not absolute change in price, but the relative change in price compared to the range.

The same idea applies to time. If the frame is established as a 2-minute wait; then a 3-minute wait seems like a lifetime. When you go out to a fancy restaurant, you accept that you are going to wait awhile to be served; presumably associating the time waiting to the quality of the food.

These ranges are intimately related to the idea of reference dependence: outcomes are good or bad not based on some absolute value, but on their relative value compared to some reference point. We reset our sense of value so that the things better than the reference point are seen as good, and things worse than the reference point are seen as bad.

The Weber-Fechner Law is a simple rule that captures the key features of the paradoxes we are observing. When we perceive, remember, or make decisions about small quantities, the range of potential values is small and we can be very precise. Small differences matter when we are dealing with small ranges.

But when we are dealing with larger quantities, there is an increase in the range of potential values. This makes our judgment less precise: we don't notice small differences against that backdrop. Once our range expands, differences need to be much larger to matter.

Why? Consider the biology behind these effects. We have to operate during the day as well as night. And the decision-making structure that developed to optimize our performance is the one that is deployed when we choose a cup of coffee or a wide-screen TV.

Neurons can fire slowly (every second or so) or they can fire rapidly (100 times per second). The same biological range needs to accommodate a much larger stimulus range.

Our brain adapts from processing small quantities to processing big quantities by changing the scale. The cost of this adjustment is

precision: 5 dollars matter for a cup of coffee but matter not for a wide-screen TV.

Implications:

- The Weber- Fechner Law states that a meaningful difference in some quantity is inversely proportional to its range. Differences become less meaningful as quantities get bigger.
- Recall the concept of loss aversion. Head you win \$11, tails you lose \$10. Most people won't accept this lottery unless the potential gain is twice as big or bigger than the potential loss.

Think of people's decision-making as adaptive. We don't just have one mental machine that processes all our decisions the same way. We have a set of adaptive, flexible tools that we can bring to bear on a range of decisions, and we adjust those tools as needed. We can use the same tools to accommodate the magnitude needed for big decisions, and the precision needed for small decisions.

Therefore, there are no big decisions. And although this phenomena has a biological cause, it is not destiny.

First. If you have multiple decisions to make: start small. Resolve the small decisions first. Starting large – as many of us are wont to do, to “get it out of the way” - handicaps you. If you start large it may be difficult or impossible to recalibrate rapidly enough to make good decisions about smaller amounts of money.

Second. Avoid or recognize frames whose purpose is to lull your sensitivity to small effects. Realtors typically and pretextually, take you to view a house that is way above your price range. This imprints the setting on your brain – deliberately subjecting impairing you small-frame decision making capacity.

You are going to the store to buy wine. You have to choose between an \$8 one and a \$15 one. You would typically be happy with the \$8 one. But the presence of a \$35 bottle of wine affects your

decision by stretching your range. The difference between the 8 and the 15-dollar bottles will seem less meaningful by comparison.

What to do? Refuse the gambit: remind yourself that you set out to buy an \$8 bottle of wine; remind yourself that the more expensive wine does not objectively affect the quality of the cheaper one. You may also – enlarge the choice set. The difference between \$8 and \$35 is not chump change. And that money - \$27 - can be used to buy something else. Compare the money you are about to blow with the alternatives you could put that money to use.

Readings

Jonathan Baron, Thinking and Deciding (NY: Cambridge University Press, 1998).

John Payne, James Bettman & Eric Johnson, The Adaptive Decision Maker (NY: Cambridge University Press, 1993)

LECTURE XVI: PROSPECT THEORY: PROBABILITY WEIGHTING

An extremely vivid image of death and damage, constantly reinforced by media attention and frequent conversations, becomes highly accessible, especially if it is associated with a specific situation... The emotional arousal is associative, automatic, and uncontrolled, and it produces an impulse for protective action. System 2 may “know” that the probability is low, but this knowledge does not eliminate the self-generated discomfort and the wish to avoid it. System 1 cannot be turned off. The emotion is not only disproportionate to the probability, it is also insensitive to the exact level of probability.”
(Kahneman, pp 322-323).

A correct appraisal of the probability of occurrence of an event is key for both decision-making and for the modeling of decision-making. The possible impact of an uncertain outcome is not its impact alone. Rather, it is the utility of the outcome times the probability that it occurs – when there are n outcomes, v_i is the utility of outcome i , and p_i is the probability of that outcome's occurrence.

$$E = v_1p_1 + v_2p_2 + \dots + v_ip_i + \dots + v_np_n$$

This formulation provides a highly useful ordering of alternatives. Thus, the probability of occurrence is fundamental to this assessment, to the process of normative decision-making.

As it turns out, we run into problems when construing objective probabilities – we don't always interpret them properly. It is well known that if an outcome has a 96 percent chance of occurring, we should treat that outcome as twice as important as one that has only a 48 percent change. And we should treat the outcome as four times as important as one that has a 24 percent chance of occurring. And 96 times as important as one that has a 1 percent chance of occurring. The appraisal of probabilities of occurrence –recall- should be consistent; this is, in fact, required by the Expected Utility model. But we don't appraise probabilities in this manner. There is a marked

difference between how we should appraise probabilities and how we actually do. We show bias – systematic bias. Specifically, (a) it difficult for us to construe objective probability of events, and, (b) we fail to use probability information effectively when it is provided to us. Think about this: the summer of 2018 had vivid headlines reporting shark attacks in the Carolinas and in Cape Cod. But we know people who expressed apprehension entering the waters of Hammonasset; a popular beach *in Connecticut*. What are the odds?

To explain this conundrum, we turn to the concept of probability weighting – to explain the bias people show when working with probability. Probability weighting is one of the two foundational concepts of prospect theory (the other being reference dependence). Our reliance of probabilities is pervasive– ranging from gambling to public policy to insurance; and thus, the likely errors resulting from our biases is critical.

What is Probability?

Probability is the likelihood of some defined event occurring. There are two common ways (and one less common) of describing the probability of something. The first is in terms of percentages – there is an 80 percent chance of rain tomorrow. There is a 0.00048649 percent chance of dying as a passenger in an airplane crash.¹⁵ The second is in terms of frequencies – that product is preferred by 8 out of 10 doctors. Although the two forms are mathematically equivalent there are important differences between the two in terms of how we process information.

Probabilities are only meaningful if they are well defined. If you are considering flipping a coin – you know that there is a 50 percent chance of it being heads. The events are exclusive (either heads or

¹⁵ National Safety Council. [<https://injuryfacts.nsc.org/all-injuries/preventable-death-overview/odds-of-dying/>] viewed August 2018.

tails; never both; never neither) and exhaustive (the probability of one plus the probability of the other sum comes to one hundred percent).

Many other real-world events are not well defined. In a two-person political race, like our presidential elections, we may not know the true probabilities for candidate A or candidate B, but we know that only one of them will be elected. How likely is it for China to go to war over the territorial claims in the South China Sea? How likely are we to move away from using carbon fuels? Objective probabilities factor into a decision process subjectively; we refer to this transformation as “probability weighting” and the probabilities themselves as “probability weights.”

The term “weight” albeit clunky – is highly intuitive. We recognize often how a factor has a disproportionate bearing on our decisions. It means that an objective attribute of the many attributes that characterize each factor has outsize influence compared to others. Probability weighting just means that factors singled out by these attributes are treated as more important than they should be; and probabilities that are underweighted are because the attributes are discounted more than they should.

Recall how rationality meant that a decision maker had preferences that were complete, consistent, and transitive. The same applies to probabilities. Probabilities should be ascribed in a manner that is complete, consistent and transitive. Consistency requires that 50 percent seem twice as likely as 25 percent (subjectively), so that twice as much weight is given to 50 percent in a decision. So the actions take when confronting a risk set at 20 percent should be proportionate to the action if the risk were at 40 percent. Completeness requires that the total probabilities for all possible events add up to 100 percent – not more not less. So if there is a 60 percent chance of rain, it has to be the case that the chance of no rain is 40 percent.

These conditions seem obvious. Who would even think that there is a 40-percent change of heads and also a 40-percent change of tails?

Or that there could be a 200-percent change of dying from some disease? But, sadly, even these simple rules are regularly violated.

Consider the purchase of life insurance. Some insurance products combine both insurance and investments. Others are simpler. The simplest one is term life insurance: you pay an amount of money to insure your life against the possibility that you will die across a specific or defined period – or term. For the most part, term insurance is purchased for peace of mind.

Consider the following experiment found in Johnson, et al (1993). Suppose you are going to take a flight to Bangkok. You know that terrorism is a potential source of danger to travelers. You are offered a flight insurance policy that will provide \$100,000 worth of life insurance in case you die due to terrorism. You can buy insurance for the outbound flight and separately for the returning/inbound flight. How much would you pay for the flight out? The return flight? Participants were willing to pay \$14 outbound and \$19 returning, or \$33 in total.

Another group of participants was only given the option of purchasing insurance as a combo: for both flights. Theoretically, an insurance policy that combines both flights should cost exactly as much as the sum of the policies for the flights individually. It didn't: the price was \$14.

A third group of participants were given still another alternative: a super-combo insurance deal that covered both flights and the stay in Thailand. The price for this whole-trip coverage: \$7.

Although the price that people are willing to pay for insurance should be proportional to their subjective probability of needing that insurance, those subjective probabilities are distorted and inconsistent. People are willing to pay more than twice for insurance that covers one flight than for insurance that covers the entire trip.

Why are probability judgments distorted? How would you form a probability judgment for something like “term life insurance during a flight to Thailand?” One thing you cannot do is rely on your personal experience. I'm assuming you have never died while on a flight to

Thailand. Instead, you have to estimate the probability of a very rare event by constructing scenarios in your mind about what might happen. If you bring to mind a vivid scenario about and even, it will seem more real and thus more probable. This phenomenon has been given several names, but it is typically called the availability bias.

In the flight insurance example, thinking about each flight independently forces people to think not only about what might happen on each flight but also about the differences between their two flights. Bringing past events to mind, you might think that flights into the US are more dangerous than outbound flights – and the vivid scenarios serve to increase the subjective probability of a terrorist event.

When considering insurance for the entire trip you envision situations that don't lend themselves to creating a vivid scenario for terrorism – and least not to the degree of the flights themselves. So no risky event comes to mind and the subjective probability seems low.

Consider the national debate on crime, its prevention, and our justice system. Surveys consistently show that people think that the crime rate is increasing. Since the later 1980s, almost every year a substantial majority of Americans have reported that they thought there was more crime than a year ago.

The data indicate that crime rates dropped dramatically. Since the 1980s, per capita rates of both violent crime and of property crimes have dropped in half in the US. And this is worldwide and secular. Simply put, individual's subjective estimates of crime rates are disconnected from the objective rates of crime. What causes this disconnect?

If it leads it bleeds: because it captures the public's attention. So the media focuses on kidnapping, shootings, killings, etc. when they do occur. Ironically, the less frequent crime gets the more noticeable each occurrence becomes.

There is something to be said about overstating crime rates. Crime is clearly a problem even at current low rates, and fear of crime helps

mobilize people, law enforcement, and governmental agencies towards taking action. But I want to re-emphasize that our biases will affect some sort of probability judgments more than others. So crimes that are rare but very vivid are seen as more common than they really are so they can draw resources away from crimes that are common but less vivid.

- Familial kidnapping vs stranger kidnapping.
- Poor security at bus stations vs poor security at airports.

Every choice implies an opportunity costs. Resources are devoted more to rare and vivid problems compared to more common problems.

ALL EVENTS

How are subjective probabilities distorted? That is to say, how do the probabilities we sense or construe differ from the objective ones? Consider the following categories: low (up to 25 percent), medium (between 25 and 75 percent), and high probability (greater than 75 percent). An event that has an objective 1-percent chance of occurring could subjectively seem like it has a 5-percent chance of occurring. Similarly, a 10-percent chance of occurring could seem like a 20-percent chance.

In general, the smaller the probability, the more we overestimate its likelihood. Consider the lottery; this is what we tell ourselves: (a) you can't win if you don't play; (b) someone has to win, it might as well be me. The odds of a single ticket winning the largest, most popular US lotteries are on the order of 1 in 175 million.

Let's change the frame. The probability of a single ticket winning a mega millions lottery is 1 in 175,711,536. The chance of being stuck by lightning is 1 in 10,000. The chances of being struck by lightning in your lifetime is 1; 10,000. The chances of being struck by lightning twice in our lifetime is 1 in 100,000,000. So you are more likely to be

struck by lightning twice in your lifetime than to win the Mega Lottery Jackpot. Does overestimation of probabilities explain the popularity of lotteries? Not completely.

One factor comes from how our brain processes rewards. The brain's dopamine system does not respond to rewards – it responds to signals about future rewards – to anticipated rewards. It is the possibilities of what we can do with those winnings that drives us. It is not necessarily irrational to spend \$1 on a ticket in order to obtain those feelings of anticipation. It's the getting there what counts.

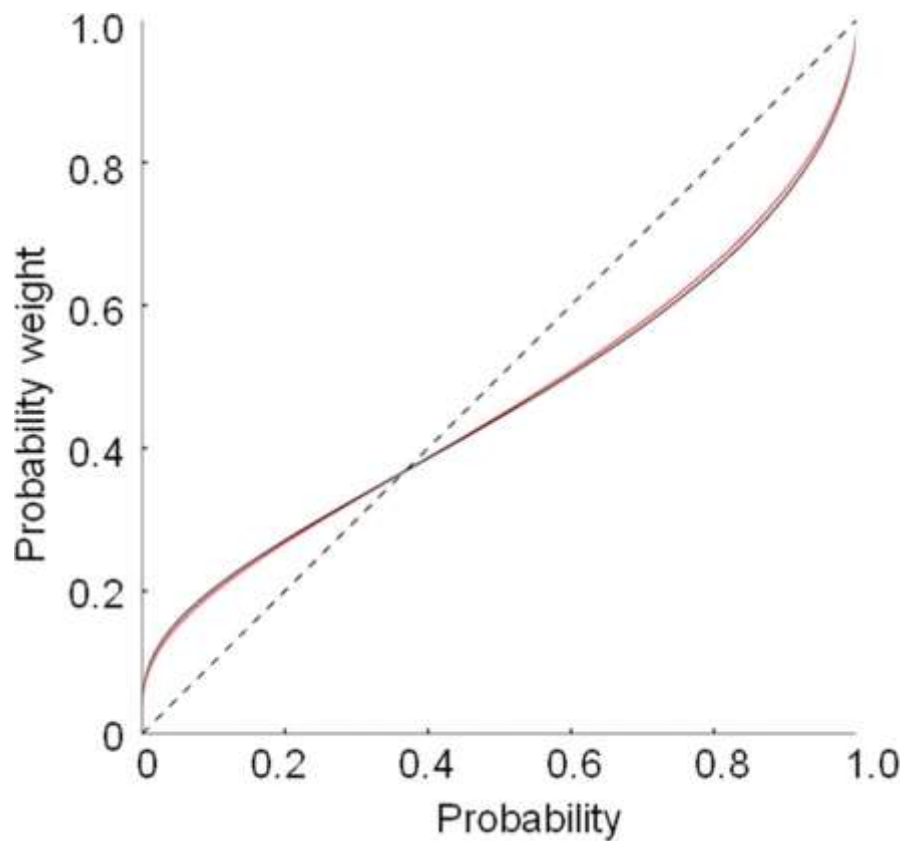
Consider events of medium probability (between 25 percent and 75 percent). These events might happen - or they might not. Within this range the probability weighting function flattens out, meaning that a change in objective probability is not much distorted; it doesn't have that much subjective effect.

Suppose your doctor tells you that you have a 5 percent probability of contracting a rare cancer in the next 5 years. A drug treatment is available. It has side effects – a poor quality of life ahead of you - but will eliminate the chance of cancer. Do you begin drug treatment? Now consider the same problem with a slightly altered appraisal of likelihoods. You have a 60 percent chance of getting a rare cancer –but an experimental drug can lower your chances to 55 percent. The drug has side effects – a poor quality of life ahead of you. Do you begin drug treatment?

It's not that changes in probability are irrelevant in the middle ranges – just that less of a subjective impact than at lower or higher probability events. Roughly, for every 2 percent change in objective probability there is slightly less than a one percent change in subjective probability.

Finally, consider high probability events – those above 75 percent. Those events should happen, even though there is a chance they might not. But people underestimate their chances. An event that should happen with a 90 percent probability might seem subjectively like a 75 percent chance, while an event that should happen with a 9 percent probability might seem subjectively like a 95 percent chance.

This is what the relation between objective and subjective probability looks like:



This implies that people tend to be more conservative than they should when the odds are in their favor. In court cases, plaintiffs who face favorable odds of prevailing on an existing lawsuit might settle for lesser amounts; gamblers bet on horse races tend to bet too much on low probability longshots and too little on high-probability favorites.

Conclusion

Our subjective sense of probability doesn't match the objective reality. Our assessments are biased. We cannot know the exact probabilities so we estimate them. We construct narratives about what could happen, based on our memories of yesteryear and our reasoning about similar events.

Unfortunately, we cannot eliminate these biases; but we can curtail some of their more dramatic effects via the following strategies.

First, use the availability heuristic to your advantage. Vivid stories carry the day. So think about an event in a way that makes it less vivid – minimize its ability to overwhelm you. You could distance yourself from the event by imagining that you were advising someone else. If that were the case – what would you tell them? Would you advise your friend against taking insurance out for your smartphone – given the high cost and low probability of needing replacement? Can you advise against a camping trip to Connecticut because it is ground zero for Lyme disease? What we are doing is tempering our vivid imagination. Only then can we improve our appraisal of the likelihood of occurrence of low and high probability events.

It's more difficult in the middle ranges. The problem is not inaccuracy. Rather, it is insensitivity to changes in probability. The rain forecast changes from 64 to 58 percent; we have no sense of proportion against to which we can gauge this – nor does it come intuitively.

What might help is to think about probability in terms of frequency. Instead of percentages use frequency. 1 in 10 rather than 10 percent. Here is another example. You are asked to consider taking drug x to reduce the risk of influenza from 60 percent to 40 percent. Here is the same situation in terms of frequencies: for every 10 people who take the drug, two of them avoid significant illness. You could be one of those two.

By moving away from the abstract probabilities and emphasizing concrete individual cases – in effect counting, the frequency representation calls attention to the key fact: there are people who benefit from this course of treatment.

To be sure, these recommendations have their limitations. Some events are just too vivid to dismiss: your probability judgments are likely to be inaccurate regardless. But by knowing your bias, and by thinking about probabilities in a different way, you might improve your odds.

Readings

Daniel Kahneman, Thinking, Fast and Slow (New York: Farrar, Straus and Giroux, 2013).

LECTURE XVII: TEMPORAL DISCOUNTING

*In sum, every purported probability distribution actually
floats in a sea of uncertainty.
Jim Manzi (2012)*

The decision to save for one's retirement entails choosing to reallocate money throughout time – an intertemporal choice. Saving is refraining from spending an amount of money today so as to allow it to grow. This sacrifice today enables us to spend a larger amount of money tomorrow. Sacrifice now; reap benefits tomorrow. Easier said than done. In this lecture we examine why these decisions are so challenging and why are they often wrought with mistakes – wrong choices. Discounting means a reduction in value; so “temporal discounting” means a reduction in value because of the anticipated passage of time.

Consider which one of the following choices would you rather have? \$100 today or \$110 in six months? Most people prefer receiving \$100 today – the smaller, more immediate reward. This implies that the value of money diminishes over time; we'd rather have less now than more later.

Now consider: \$20 today or \$200 in one month? Most people choose \$200 in one month, they pick clearly larger, more remote reward. We can back-out a relation describing how time influences the subjective value of money from the questions and responses: this is the temporal discounting function. People vary tremendously in their (im-) patience. Some people are willing to wait; they see no difference between \$48 now and \$50 in 6 months. Others have no patience at all: (high discount rates). They value \$20 now equally to \$50 in one month.

Interestingly, waiting to reap benefits – temporal discounting is not of human exclusivity; it is present across a wide variety of animals. Rodents and birds exhibit caching behavior. They put aside food in hidden caches during times of plenty, and then return to those

caches when times are lean – often weeks or months later. In effect, these animals are engaging in some form of temporal discounting—spending effort to store food now, so they have sustenance later.

Most animals are impatient. They exhibit very steep discounting for rewards like food and juice. Consider that people often delay monetary rewards for 40 years or more – approximately 20 million minutes, compared to two or three minutes for a chimpanzee. But this realized difference probably has to do with the special *relationship* between money and humans more than anything special about humans per se.

Consider humans and discounting squirts of juice or viewing photographs of attractive faces. When we test humans with these sort of rewards, then it appears that human discount rates are comparable to those of our primate relatives. Humans are not willing to wait more than a few seconds to minutes to view a more attractive image or to get a larger squirt of juice. There is something special about money.

Recall the patient person. One who is willing to wait 6 months to gain \$2. This is equivalent to an investment with an effective rate of return of about 8.5 percent per year; this is roughly similar to the average annual returns for the broad stock market over the past 50 years. Taking \$100 now rather than \$110 in 1 month – is akin to turning down a risk free investment with a 214 percent annual return.

People assign decisions to different mental accounts and apply different rules to each account. The same person who has some of her retirement savings locked into long-term treasury bonds that return two percent per year can come into the laboratory and turn down a guaranteed return of almost \$200 per year. The retirement savings and the earnings in the laboratory reflect two different mental accounts. It would be efficient if we applied the same rules in all settings so that we wouldn't be too impulsive in one setting and too patient in another.

Why do we discount? There are three explanations as to why rewards are worth less in the future than they are in the present. First, delayed outcomes are risky in the sense that the anticipated outcome

might change. Our personal circumstance might change. We expect a risk premium for waiting – a higher expected return for investing in something risky when compared to a risk-free alternative. The longer the delay, the greater the risk, and thus the less a future reward should be worth.

This cannot be the only explanation however because people's attitude towards risk and their attitudes towards delay are only weakly correlated. Someone who is risk-averse might also be very patient in their temporal decisions, – even though being patient is riskier. Similarly, when people face large decisions, thousands of dollars, they become more risk averse but also more patient. So temporal discounting is not just a natural response to risk.

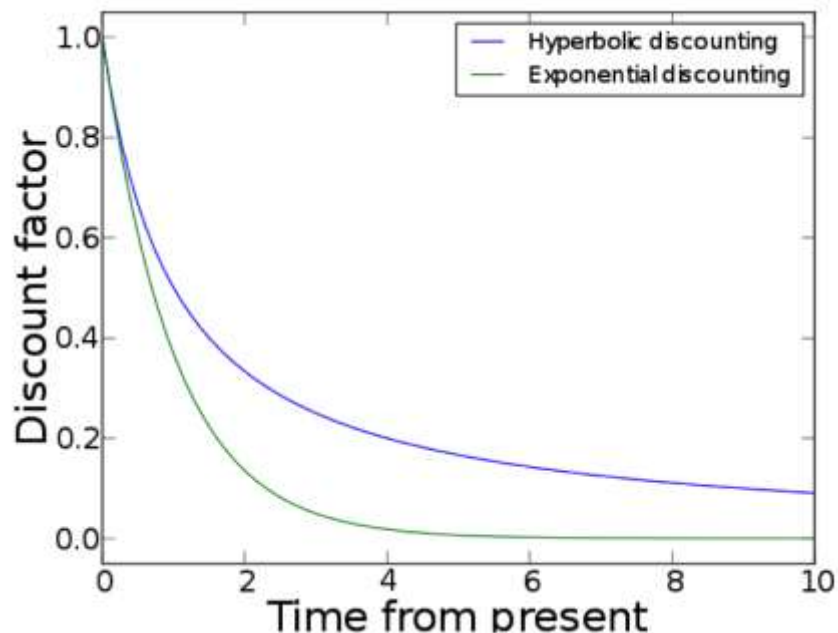
Second. Temporal discounting arises from temptation. People tend to discount primary rewards such as food and juice more rapidly than money. In fact, more tempting rewards like candy, chocolates, or potato chips) show faster discounting for that reward than other similar rewards. And addicts show very, very rapid discounting for drug-related rewards. They value drugs when they can be obtained right now and quickly discount the value for future drugs to almost nothing. But temptation doesn't explain why we show high discounting for money, especially when we don't desperately need that money right now.

There is a third possibility. Consider a 25-year old single male who is just beginning to save for retirement. Every dollar saved is a dollar not spent today; it is not available for dinner with friends, for running shoes; available for none of the activities we value today. Instead, he is setting aside for the as-yet-unknown desires of his 65-year old self. Perhaps his 65-year old self will like to travel, or support charities – or have long term medical needs. Junior doesn't know and cannot know that his 65-year old self will use the money for. He just knows that it is a good idea to reserve some of his current money for his future self. This third perspective can guide us towards specific steps that help us resist temptation, become more patient, and save for retirement.

Key Anomalies of Preference Reversals

Preference reversals are flips in preference from one reward to another as time passes. Imagine two decision makers: Bob and Jane – each characterized by average patience in their intertemporal decision-making. To Jane, the value of money decreases at a constant proportion over time. One hundred dollars might lose 10 percent of its value over one month, an additional 10 percent over the 2nd month, and an additional 10 percent over the third month, and so forth. The first month is no different from the third month is no different from the 6th month. The value declines steadily. Jane's temporal discounting function would look like a smooth curve that starts high and then loses 10 percent of its current value each month. The mathematical term for a curve displaying those characteristics is an exponential function.

Bob has a different take on time and money. To Bob, the present matters much more than the future. So \$100 now might only be worth \$75 after a 1-month delay, and only \$60 after two months. But future times don't matter as much to Bob. He doesn't really care much about the difference between 11 and 12 months or between 12 months or 13 months. Bob's temporal discounting function for \$100 would decline much more sharply than Jane's, at first, but then would flatten out thereafter. This function is a hyperbolic function:



There is consensus that temporal discounting should follow an exponential function but that it, in fact, follows a hyperbolic function.

Consider: A or B?

A: \$100 now or B: \$105 a week from now? Most people pick \$100.

A: \$100 in 52 weeks or B: \$105 in 53 weeks? Most people pick \$105

The scenarios are identical except that one happens a year from now. But people choose differently. Preferences reverse because of the passage of time.

People discount rewards faster when they are near in time. Thus, they aren't consistent with the constant discounting of an exponential function. But they are consistent with the short-term discounting of a hyperbolic function. So we may want to be rational like Jane but are impulsive like Bob.

A second anomaly are sequence effects. By itself hyperbolic discounting implies we want things now – when things are most valuable to us. And often that is true. We'd rather have money now than later, we indulge with cake even though we will need to burn more calories later. But there are situations in which we'd instead prefer to wait for a good outcome.

Here is an example from Huettel's survey. Suppose we have three gift certificates to three different restaurants. One is no frills. The second one is a fancy Italian restaurant. The third one is a casual bistro. You can dine in any order you choose. Which do you pick first. People tend to have personal reasons for picking in ascending order of quality. Temporal discounting is not working here: the most valuable option is saved for last. Why? Perhaps to relish the feeling of anticipation for longer. Anticipation is an extremely powerful motivator for our decisions. Anticipated gains lead us to purchase lottery tickets that have astronomically low chances of winning. Anticipated regret pushes people away from risky investments even when they are advantageous. Feelings of anticipation can override the normal decrease in value that comes with temporal discounting.

Third: dread – the feeling you get when you think something bad is going to happen. Think about an upcoming unpleasant experience: that's dread. Paid to be in a study with electric shocks. It's extremely aversive. You'd think most people would want to postpone the aversive shock as much as possible. But that's not what happens. Many people prefer the larger shocks immediately instead of waiting for a smaller shock. This is opposite to standard temporal discounting models.

The brain simulates the upcoming negative experience. That waiting period, that feeling of dread, is itself aversive. People actually find the experience of dread sufficiently aversive that they are willing to take their lumps now – so they don't have to wait and dread any longer.

Readings

Scott Huettel, Behavioral Economics: When Psychology and Economics Collide (The Great Courses: 2013)

Daniel Kahneman, Thinking, Fast and Slow (New York: Farrar, Straus and Giroux, 2013).

LECTURE XVIII: CONSTRUCTED PREFERENCES

“The idea was fantastically, wildly improbable. But like most fantastically, wildly improbable ideas it was at least as worthy of consideration as a more mundane one to which the facts had been strenuously bent to fit.”

— Douglas Adams, *The Long Dark Tea-Time of the Soul*

There is nothing more fundamental to the rational model as the notion that preferences are constant. This assumption is the foundation of the models that undergird much conventional empirical work in economics. Conventional theory currently classifies individuals on such dimensions as “risk preference,” “time preference,” and “altruism.” Across these dimensions people have stable and consistent preferences. It matters not how and under what circumstances the preferences were formed, the task is merely to gauge them when they are “revealed.”

The upshot of this reasoning is that someone who is risk-seeking when making vacation decisions is expected to be risk-seeking when buying groceries. But, as it turns out, preferences vary across domains because preferences are state-contingent. Again, they depend, or more precisely, they are influenced by context. Formally, preferences are constructed.

The idea of constructed preferences likely vitiates, but certainly challenges the conventional assumption of fixed preferences. At its core, the idea that constructed preferences depend on context is to recognize that subjective value is something we create to respond to the decision under consideration. We don’t necessarily have intrinsic preferences that determine our choices of different goods – for example, that an apple is worth more than a dollar. Instead, choices are influenced by contextual, environmental, and framing factors that seem unrelated to well-being; we figure out what is important to us at the moment. The notion of our brains as computer hard drives and that all remembering requires is to reach back and “read” or “extract”

a particular file is a disservice, analytically.¹⁶ Memories aren't looked up and processed as integrated wholes; rather, they are constructed from different elements at the time of retrieval.

There are two decision biases that creep in when we confront choices. The first is called the decoy effect or also known as the attraction effect (formally it is the asymmetric dominance effect). The decoy effect refers to situation where the introduction of an additional choice influences our determination of value. Specifically, the presence of an irrelevant alternative biases us towards an option that seems objectively better than the decoy. Business folks, from shopkeepers to marketing concerns often use decoy effects.

But it is not relegated to business alone. Political scientists have argued that decoy effects can influence elections. For example, the deliberate introduction of a third-party candidate – a tactic known as a stalking horse - can influence voters who would otherwise have remained steadfast in their choices.

The second decision bias is called the compromise effect. In situations where it is ambiguous which option is better or worse or where two options are surrounded by ambiguity we tend to compromise. We tend to “split the difference,” – and pick the intermediate choice that seems like a compromise between the two extremes.

We choose a middle option because it is easier to justify and less vulnerable to criticism. And if we consistently compromise, we can be exploited. A cigar bar can make an expensive cigar seem reasonable by adding an even-more-expensive stick to the humidor.

¹⁶ This disservice alludes to Polanyi's paradox. Polanyi's paradox (named after Michael Polanyi who wrote: “we know more than we can tell”; in context it “suggests that despite massive advances in computation-based tasks via machine learning tools, comparable gains have avoided human sensorimotor skills. Sensorimotor skills, common sense, judgment, intuition, creativity, spoken language, still remain the preserve of humans. In other words, “Polanyi's paradox means that many familiar tasks, ranging from the quotidian to the sublime, cannot currently be computerized because we don't know ‘the rules’ (Autor, 2014).”

Edward Fredkin noted: "The more equally attractive two alternatives seem, the harder it can be to choose between them—no matter that, to the same degree, the choice can only matter less." This has come to be known as Fredkin's paradox. Formally, it notes the negative correlation between the difference between two options and the difficulty of deciding between them.

Constructed preferences lead to oddities like preference reversals resulting from decoy effects, and compromise effects. So why do we construct value if it leads to so many mistakes? Why aren't our preferences more consistent and stable, so that we can simply retrieve them when needed?

There are two answers. The first answer is that, as with all biases, context-dependent effects actually help us make decisions – and it is only natural that we focus on the instances in which they lead to errors. Suppose you are faced with a difficult choice between two or more items with multiple attributes, where some of the attributes may be vary slightly whereas other attributes vary a lot. These items may have different advantages and disadvantages resulting from the differences. But we are hard-pressed to make meaningful use of the differences; it is often difficult to know what's really important as a result of the variation in the attributes. Moreover, the decision-making impasse triggers highly unpleasant cognitive-dissonance.

So if there is an option that we can live with – either because it is clearly better than some other option or because it is a good compromise – you can choose it and get on with it. Choose and stop the unpleasantness associated with indecisions. None of these biases overrides all other factors that motivate your decisions; instead, they tend to push you one way or the other when you are faced with a particularly difficult choice.

The second answer is of a different nature. Our preferences are constructed because that is how our brain works. We don't always know what factors or attributes are going to be relevant to a decision, in part because across our life and throughout our lives we have to value such dissimilar things: we weigh time versus effort, we trade

money for food. To do this we have to have a common currency for value.

How to Deal with Pliable Preferences

First, realize that variety is not always the spice of life; variety for sake of variety may exist merely to compel your decision-making. So, probe the nature of the attribute variation you are being offered. If you are trying to decide between two similar items, step back and ask how much you'd be willing to pay for one of them. Then ask how much would you'd be willing to pay for the other. You may arrive at a different decision by thinking about items independently instead of attempting to gauge the incremental value ascribed to the different attributes – and to ponder whether they are worth it.

Second, knowing that you are going to be confronted by multi-attribute options or a range of options, decide ahead of time what you are willing to commit to. Walk into that liquor store committed to paying no more than 12 dollars for a bottle of wine. Recognize the behavioral “pull” of bottles placed to act as a decoy – and refuse the invitation. Refuse the invitation by understanding how your internal homunculus decision-maker is convincing itself to succumb and blow 10 more dollars for a more expensive wine only because it sat alongside a 50-dollar bottle. Are you compromising for compromising cause of the presence of the more expensive bottle? Stick to your guns, refuse to be pulled!

We noted earlier that it is difficult to alter your behavior even when you fully understand all behavioral peccadillos and pitfalls. Recall Fredkin's paradox; sometimes a decision hangs on what are inconsequential attributes; but you don't realize they are inconsequential until you step away from the situation. So choose and be done with it. In the next lecture we talk about chance and leaving decisions up to a flip of a coin. So flip a coin. Again, the outcome is the same. You choose in a manner where you avoid the distress associated with the choice – and then you realize it was all for naught.

Further Readings

The decoy is the name given to what is formally known as the asymmetrically dominated option. It dominates the first option in terms of the perceived value of one of its attributes. The decoy attributes have been deliberately adjusted to make it more attractive than first option's attribute. The concept of asymmetric dominance is attributed to Joel Huber, John Payne, and Christopher Puto, "Adding Asymmetrically Dominated Alternatives: Violations of Regularity and the Similarity Hypothesis" *Journal of Consumer Research*, Vol 9, (1982), pp. 90-98.

Fredkin's paradox refers to the difficulty in choosing between slightly different alternatives. The paradox was mentioned in Marvin Minsky, The Society of Mind (NY: Simon & Schuster, 1986). A related concept is Barry Schwartz's "paradox of choice." The phrase alludes to the fact that vendors find sales reduced when they offer too much variety in their product lines. It is the case because consumers resort to heuristics when choosing across the lot to avoid the cognitive duress involved in choosing. Barry Schwartz, The Paradox of Choice (New York: HarperCollins, 2004).

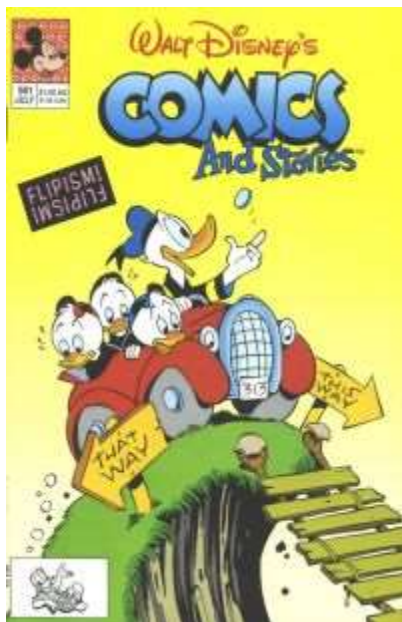
[Barry Schwartz: The Paradox of Choice, TED Talk.](#)

LECTURE XIX: CHARTING YOUR RAMBLE: THE ROLE AND RELEVANCE OF CHANCE

A PSYCHOLOGICAL TIP

*Whenever you're called on to make up your mind,
and you're hampered by not having any,
the best way to solve the dilemma, you'll find,
is simply by spinning a penny.
No -- not so that chance shall decide the affair
while you're passively standing there moping;
but the moment the penny is up in the air,
you suddenly know what you're hoping.*
Piet Hein

In the 1950's there was an oddly appealing movement called flipism. Flipism held that all decisions were to be made by chance. It could be any random number generator, a coin, a die. Although reliance on sortition - chance - to assist decision-making harkens back to the days when animals were sacrificed and bones were cast, the origins of flipism - the modern day movement - is traced back to the Disney comic "Flip Decision, by Carl Barks, published in 1953.



In the comic book, Donald Duck meets Professor Batty, who persuades Donald to make decisions

based on flipping a coin at every crossroad of life.

"Life is but a gamble! Let flipism chart your ramble!" And although Donald soon gets into trouble when following this advice, in the end, flipism shows surprising efficiency in guiding some of

Donald's decisions. More recently, in a clever twist on flipism, George Costanza, of Seinfeld fame, resorts to taking the decision opposite to the one he normally would take when confronted with choice.

In fact, Reid Hastie and Robyn Dawes observe how human beings abhor uncertainty. And that “a common way of dealing with our experience of the uncertainty of life is to ignore it completely or to invent some 'higher rationale' to explain it, often a rationale that makes it more apparent than real.” But although Flipism is of an entirely different pedigree to Proverbs in the Bible, it counts itself among many, many, other strategies similarly deployed by people to cope with uncertainty including Feng Shui, belief in astrology, tarot cards, Ouija boards, psychics, body parts of saints. In fact, In Chinese society, fortune telling is a respected and important part of social and business culture. Fortune tellers serve functions comparable to management consultants and psychotherapists in Western society. Many business and investment decisions involve the input of fortune tellers. Reliance on fortune-tellers transfers business risks – and potential blame - outside of the organization. Thus, absent the wastefulness of the blame-mongering positioning among decision-makers that occurs in many organizations prior to a risky decision being taken may result in faster consensus among competing factions. In doing so it constitutes a mechanism for rapid decision-making. As psychotherapists, they may help people discuss and resolve personal issues without the stigma of illness.

Yet relying on artifacts or devices, some more complex or sophisticated than others does not suggest that we are poor decision makers. To the contrary. Their presence attests to the strengths of our evolutionary constitution. You are here today, because one of your ancestors learned to scamper away from rustling sounds and heed the sighting of a few predators and turn towards a different direction. What joins all these heuristics is our ability to ascribe or attribute causation to events – whether it exists or not. Better safe than sorry proved to be evolutionarily advantageous. We cope with uncertainty

by attributing its provenance to something – even if that something is naturally random. And survive.

Despite huge advances in our understanding of the natural world, the outcomes of many modern human endeavors remain a combination of skill and chance. Most people, when pressed, would acknowledge that individual agency (effort) and chance play a role in the outcome of many activities: sports, business, investments, education. However, most of us have a poor sense of this duality and even less so of the relative contribution of chance and or agency (individual effort).

Why is understanding the nature of the split important? An awareness and understanding of the extent - or, more precisely, the limits, - of our control over outcomes conveys not only a refreshing operational humility but enhances our ability to recognize the advantages of embedding adaptability and contingency buffers into our actions and embrace less of a hard-headed fealty to strategic plans.

Consider business. Decision-making followed by business or financial success is hugely celebrated if the outcome is positive and severely chastised if the outcome is negative. The resulting quality of the outcome – when it is revealed - inevitably creeps into the appraisal of the quality of the decision. A manager or CEO is rebuked and even ousted given a poor outcome, even if it is demonstrated that the unfortunate event was attributable entirely to chance.

The reverse is also true. A poor, albeit lucky manager, will continue in place – wreaking havoc, again, for the wrong reasons. Bestselling managerial books and case studies such as Jim Collin's (2001) "Good to Great" or General Electric's success story during Jack Welch's reign are expressions of a one-sided focus on other people's successes.

Consider Sports. Bob Abelson polled baseball fans to estimate the relative contribution of skill versus luck when it comes to hitting. The median estimate was 25 percent. The true answer is approximately 0.5 percent; skill that is. It is an extraordinary magnitude of error – made more significant by the fact that baseball

is an entirely familiar domain: chockful of statistics, and one that does not suffer from a “small numbers problem.”

Consider academic performance. To many, personal success or failure in school depends on individual agency: personal initiative and responsibility. To others, educational performance depends largely on chance.

These interpretive contrasts across domains represents bookends of an ideological spectrum where views differ on the weight ascribed to each component in the resolution of outcomes. Libertarians place greater supremacy on the individual and minimize the influence of chance. Egalitarians, on the other hand, view the fortunes of those disadvantaged as heavily beset by chance or “moral luck.” Some of us believe that if people are poor or addicted, they brought it upon themselves. And thus, there is no obligation for us to help: they chose to do what they do. The other side of that sentiment is a smug appreciation of our own hard-work and initiative in our successes. And given the biasing effect of retrospective memory, both of us accept these judgments.

These competing appreciations of the role of chance have generated deep disagreements over the role of government in many policy spheres and resulted in conflicting goals in government policy. This understanding of the role of agency versus chance is a foundational belief – rarely informed by data or facts. It would be - for Douglass North - an instance of a mental model that sits astride a shared framework of mental models. Mental models provide groups of individuals with both an interpretation of the environment and a prescription as to how that environment should be ordered. To North and other institutionalists “beliefs” and “perceived reality” are critical in shaping the prospects of institutional change.

Our perceptions of reality – of the nexus of cause and effect relationships that govern the physical and social environment – will influence the types of beliefs that we form. “Beliefs” are propositions to which we assign truth value; these include positive beliefs about cause and effect relationships as well as normative beliefs about

justice, virtue, and other considerations. These beliefs shape and inform the kinds of institutions that emerge, the constraints governing institutional evolution, and the organizations that form in response to the institutions. Generally, organizations enact policies, policies create outcomes, and these outcomes alter our perceptions of reality. Over time, institutional, economic, and social change will be slow, incremental, and, in many respects, fundamentally unpredictable.

As with all such closely held beliefs it would matter little if we were given applicable information to illustrate its relevance or lack thereof. In an example of both optimism bias as well as self-serving bias, if and when confronted with critical data we are likely to interpret it in a manner consistent with our own views. Moreover, we are likely to skew the evidence favorably towards our interpretation of events. Perhaps more striking is the fact that unaware of our skewed information processing trait we are prone to remain smug in our conviction that our judgments are free of bias.

Recall John Rawls famous thought experiment. Rawls suggests that you imagine yourself in an original position behind a “veil of ignorance.” Behind this veil, you know nothing of yourself and your natural abilities, or your position in society. You know nothing of your sex, race, nationality, or individual tastes. Rawls contends that if “rational persons concerned to advance their interests” found themselves in this type of original position, they would agree to a social contract in which there existed an equal distribution of liberties and social goods.

This illusion of personal control or a sense of the existence of some causal ordering of the universe is at the core of superstitious behavior. Superstitions are likely to emerge in the face of any uncertainty but are particularly likely to develop when the outcomes of behaviors involve components of both skill and chance.

If you swung your bat three times counterclockwise when on the batting circle and then followed that by a massive triple to center field you will undoubtedly remember. It would be impossible to distinguish the relative contributions of skill and chance unless you

systematically varied the batting circle routine and noting the outcomes to determine whether they are meaningfully distinct outcomes. But no one does that. We tend to repeat what “works” and change what does not work.

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LECTURE XX: SEARCH, EXPERIENCE, & CREDENCE GOODS

“Life consists of building future memories.”
G. Cabrera-Infante

In conventional economics, a product is a product regardless of its nature: it's all widgets and gadgets. Thus, for conventional economic analysis there is no meaningful economic difference between purchasing intangible services, experiences like vacations, or concerts, visiting your auto-mechanic or taking your dog to the veterinarian, and physical goods like electronics and cars and corn-flakes.¹⁷

However, it is possible to distinguish between **experience goods**, **credence goods** and **search goods**. The ease of evaluation of the quality of the good and the information available to the parties to the transaction serves as dimensions along which we can classify all goods and service

For consumers, market transactions supply not only goods and services but also the information that can help us form rational beliefs and improve further consumption-related decisions. Rational Bayesian updaters make inferences based on information provided by the transaction and information accompanying the transaction. When markets offer better and more readily available transaction information, consumers' judgments and decisions may be more accurate and better aligned with their preferences and it reduces the costs of trading or transacting.

¹⁷ Of course, in more sophisticated economic analysis there is the distinction between durables and non-durables. As its name indicates durable goods are longer lasting. And the increased supply of durables into a market does have intertemporal impact with important economic consequences. We abstract from these considerations to emphasize the distinction made possible by categorizing goods by the dimension of their quality and the sensorial experience they elicit.

Products can be viewed as a bundle of attributes. Thus, a banana purchased today bundles know-how about tropical agriculture, shipping practices, vertical integration market structures and more.

The features and quality of some products can be ascertained before you consume them; these goods are known as search goods(e,g). a laptop, a mobile phone, etc.

The quality of other products is ascertained only after you consume them: restaurant meals, a show, a bottle of wine. But for still some other goods, it's impossible to ascertain features or quality even after consuming them: credence goods. Within this category we include transactions such as a visit to the dentist, the auto-mechanic, hiring a plumber or seeing a vet.

The nature of some transactions create asymmetries of information between parties. In some instances, the supplier has information that the purchaser has no way of ascertaining. Thus, unless there is some means for prospective buyers to ascertain the quality of the product, there may be a fudgy, inefficient market, a market riven with fraud, or there may not be a market at all.

Search goods are more subject to comparison leading to competition via price and other attributes. Comparison leads to product substitution. Consumers can easily verify the price of the product and alternatives at other outlets or online. The process of commoditization – where competitors adopt practically identical features and terms, acts to transform a product from an experience good into a search good. Otherwise, the presence of differences makes them more difficult to compare and would raise transactions costs.

Experience goods are a bit more difficult to choose. In service areas, such as healthcare, they reward reputation and create inertia and market “fudginess.” Experience goods typically have lower price elasticity than search goods, because consumers associate lower prices with unobservable problems or quality issues.

It is difficult for consumers to ascertain the quality of credence goods and services even *after* they have consumed them. For

example: vitamin supplements, education, and car repairs. Potential consumers of these goods may require third-party information, provided by private rating agencies or government bodies. In fact, it is not exclusively ratings; in the interest of trade and capturing value a variety of third-party institutions arise to overcome the information problems inherent in the experience goods market: trust enhancing and reputation verification norms and practices emerge in the ecosystem surrounding the markets for experience goods.

As it turns out, it is precisely the asymmetry of information required for the delivery of credence goods – we don't know exactly what we need; all we know is the car is misfiring and making funny noises - which defies comparison shopping that creates inefficiencies and misallocation of resources. And as it turns out, their sometimes intangible nature and our limited understanding of the underlying and often technical particulars defies comparison shopping. We can't really tell how good that dentist is. As a result, experiences are likely to be undervalued. But they aren't as short-lived as they seem. We are often better off spending money on experiences than we are on material goods.

Why are positive experiences more satisfying? First, some definitions. Material goods are computers, furniture, clothes, cars, books, and houses. They are physical things that can be touched, handled. We can save them for later. Experiences are the perceptions, feelings, emotions, and memories evoked by some event. Experiences are idiosyncratic, particular to each of us, and thus, we can't trade them to others; we can't save them for later. In fact, often we are hard-pressed to fully describe them, without resorting to aesthetic, ethereal jargon. But materiality and experience are not distinct product features really; we experience all goods and services and every product has materiality or durability. In fact, materiality or durability and experience are more like attributes or characteristics of any product where the difference is on a spectrum. The one feature that separates goods however, is time. Material goods last; experiences are temporary.

Undervaluing Experiences

According to Carter & Gilovich (2010) the evaluation of experiences tend to be less difficult than evaluating tangible goods. From a cognitive perspective, experience goods are potentially less awkward or difficult to compare than material possessions. Participants were less satisfied with their material purchases because they were

- (i) more likely to deliberate and ponder about unchosen alternatives;
- (ii) participants tend to *maximize* when selecting material goods and *satisfice* when selecting experiences;
- (iii) participants' satisfaction with their material possessions was undermined more by comparisons to other available options, to the same option at a different price, and to the purchases of other individuals – when compared to experience goods.

Experiential purchase decisions are easier to make and more likely to enhance an individual's well-being. Choosing between experiences is often easier than choosing between material possessions: having abundant options is less troublesome for experiences than it is for possessions. This may be one reason why people tend to derive more enduring satisfaction from their experiential purchases than their material purchases

Why might the utility derived from experiences tend to be less reliant on comparison than the utility derived from material possessions? One reason is that the very material nature of possessions makes them easier to compare. Someone in the market for a wristwatch can hold two watches side by side, readily compare their aesthetics and features (even try on both simultaneously) and come to a conclusion about which one is preferable.

Comparing two potential experiences is typically more difficult. Imagine, for instance, that you're trying to decide between two vacation packages. You could lay out the pamphlets for the two vacations to compare them, but the comparison will be remote and difficult. To be sure, it is not hard to imagine what it would be like to ski the powder in Vail or ride the waves in Fiji. But it is not possible to actually be in both places at once, and so any such comparisons are mere forecasts - simulations, not tangible evaluations.

Also, not only are experiences harder to compare than possessions prospectively experiences are also harder to compare retrospectively, with implications for how much regret they elicit. As many theorists have noted, the likelihood and intensity of regret depends on the ability to compare the option chosen with options foregone (the alternative not taken). You feel regret because you can more easily visualize the path not taken.

Because it is often relatively easy to compare a possession one has with a possession one might have had, material purchases may be more susceptible to post-choice regret. No matter which wristwatch one buys, even if it is entirely satisfactory, it can still be compared to one in a store display. This replay ability encourages counterfactual thoughts about what it would be like with their positions reversed.

And as for experiential goods, after returning from vacation, in contrast, it is not so easy to compare a hypothetical Vail ski run with the waves actually ridden in Fiji. But there is another reason why the enjoyment of experiences is often less amenable to comparison than the enjoyment of things. Even when comparisons are noted between the experience one had and an experience one might have had, they have less cognitive dissonance than similar comparisons between actual and potential possessions.

Finding out that there is an even better restaurant (at the same price) than the one at which you dined can be troubling. But this discovery is not as troubling as finding out that there is an even better MP3 player than the one you just bought (at the same price). The

experience is transitory whereas the MP3 player exists as a constant reminder of the better alternative.

Consider the following perplexing comparison. [Solnick and Hemenway](#) (1998), in a survey of positional concerns (i.e. relative standing), found that a majority of respondents would prefer to live in a world in which they made \$50,000 and everyone else made \$25,000 than a world in which they made \$100,000 and everyone else made \$200,000. That is, people were willing to take a \$50,000 pay cut in order to have a larger income than their neighbors. This is noteworthy because conventional economics contends that an individual's utility depends on his endowment, *not* on his relative position. However, not all goods and attributes mattered the same. For example, one's relative position was not relevant when it came to vacations.

Rather, a majority of Solnick and Hemenway's respondents stated that they would prefer to live in a world in which they had 4 weeks of vacation and everyone else had 8 weeks, than a world in which they had 2 weeks of vacation and everyone else had 1 week. More vacation is always better; vacations are a product distinct from income.

Finally, because our experiences influence and form our memories, they are more truly a part of us than are material goods (Carter & Gilovich, 2009). They are less easily undone, forgotten or mentally exchanged for something else. Mentally exchanging an experience involves deleting a part of the self, something that people are understandably reluctant to do. Experiences therefore tend to be reminisced, remembered and evaluated more on their own terms, and less in terms of how they compare to alternative experiences.

Although some people certainly do try to create or project an identity with their possessions, even these people would be much more willing to exchange or upgrade their possessions than their memories.

Life Consists of Future Memories

For experience goods:

- (i) We don't show the normal likes and dislike of comparison shopping.
- (ii) We do not and cannot shop as much.
- (iii) We are unlikely to justify purchases afterwards.
- (iv) We aren't too terribly upset if we find out we could have had a better deal.
- (v) We couldn't care less if someone else gets a better deal.

Experiences are subjective and internal; it is harder to compare vacations or concerts or cooking classes than it is to compare electronics or cars. Experiences are short lived, memories last.

Memories are flawed. Memories about our past consist of a set of sensations and emotions that are linked together when necessary, such as when a memory is formed and when that memory is brought to mind.

Your memory of the trip to Puerto Rico might include a visual image of the long-strip of white sand, the pleasantness of the breeze, the laughter of your family or travel companion. These sensations and emotions are stored in different parts of your brain. When you retrieve a memory, our brain reaches in and pulls these elements together and reconstitutes them into a coherent experience. And it is extraordinarily rewarding. Our brain's reward system becomes active – dopamine triggers start firing - just as when we win money or sip a glass of wine.

But memories change over time: the harshness erodes, the ugly parts are left behind, the bad parts – fade away. The net result is that our memories tend to become more positive: the fish always gets bigger in the tellin.' And the positive parts get stronger when we remember them. Dan Gilbert called it synthesizing memories, Barbara Streisand tells that "what's too painful to remember, we simply chose to forget."

More positive, cherished and enjoyable – but not more accurate. For this reason the relevance and value of memories increases over

time – even though their relation with the truth may abrade. Experiential purchases generate such long-term happiness because they generate memories. We derive value, a growing self-esteem – as we identify with our travels; their value appreciates in the recounting and sharing of our memories with our friends and acquaintances – even to the public in general: travel blogs generate considerable traffic.

Caveat: Bad experiences disappear or change – but slowly.

Replacing memories

How willing would you be to switch all your memories of your trip to the Florida keys with new memories – for example, of a trip you didn't take to New Hampshire – and its great hiking trails? How willing would you be to exchange the purchase of a material good? As it turns out, we are more satisfied with experiential purchases than material purchases. The favoring of experiential over material purchases is driven by the lingering, after-effects of the events that transpired, of the memory of the experience.

The most satisfying purchases were those generated by memories that people wouldn't give up. Experiences generate more happiness, they generate less regret than material goods. And remarkably, it is not because of the pleasantness of the experience at the time. Rather, this is the case because of the later memories the experience creates for you. It's almost as if the best part of the trip to the Florida Keys – was remembering them.

Our memories form our identity. We tend to think that people's experiences as more revealing of their true selves. We judge people by the experiences that they seek out. Our experiences become part of us; they define who we are. And we can use the knowledge of others' experience to judge them.

Being Satisfied With Your Decisions: Takeaways

Recognize that businesses are aware of the draw of experiences – and are starting to fashion the most mundane purchases as an experience seeking to capitalize on the way we privilege experience. Conversely, you may yourself enhance everyday, commonplace transactions by converting every shopping spree into an experience.

Enjoy the experience of visiting that secluded scuba diving spot you discovered. You can always buy a new phone later. Purchases of experience lead to more immediate happiness, more satisfaction with those purchases, and better memories.

Rather than thinking in terms of money when you are thinking of buying a new gadget – think instead of what you could do with the time you are devoting to this purchase. Time and experiences go together. So thinking about time is thinking about experiences what could you do in the alternative? How cool could that be? This leads to an awareness of what the new experience will do for us, the sentiments and feelings it will engender – and especially, the wonderful memories it will create.

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