

10.1 Biases in Decision Making, Part 1

Please view the following videos linked below. Think about the "funny way" our brains work:

- [Marshmallow Experiment](#)
- [Dan Ariely: Are We in Control of Our Own Decisions?](#)
(Please watch the video from 14:25 to 15:53)
- [Daniel Kahneman: The Trouble with Confidence](#)

This element addresses the following learning objective of this course:

- LO6: Navigate organizational, personal, legal, and ethical constraints to facilitate better decision making and improve communication.

10.2 Biases in Decision Making, Part 2

Well, I hope you've had fun watching some of those fun videos. The biases literature and watching people talk about biases can be really funny, and it's great stuff, particularly the fascination with how people really make decisions and how they really behave in real life. It's kind of like a Candid Camera for economists. But the not so great stuff is the ongoing debate, at least in my mind, about whether this kind of behavior is rational or irrational. It's really quite remarkable how much time academics like me spend trying to explain why some behavior that looks crazy in fact makes sense. Here's a classic example that people use. So why do people buy a car after test driving only two or at most three cars? That's a really big investment, there's a lot of time, energy, emotion, and money wrapped up in that, and you would think people would test drive five or six cars. Well, if you want to make that behavior seem rational, you tell a story where the costs of test driving another three cars exceed the expected benefits of getting a better car. But that's just a story we tell ourselves. We don't actually know that. Who has ever asked someone to measure exactly how much benefit they get or how much cost there is involved in test driving another few cars? I like test driving cars. I would do seven or eight. So in some sense, these kinds of rationality debates are referred to as kind of "just so stories." The world works as if people are rational, and they can be very misleading. But they become really misleading in particular if we use them to try to change people's behavior. So how are we going to make people drive more than two cars? Maybe we want to make them feel guilty about not getting the

information they need to make that next decision. Or if we want them to do less test drives, maybe we'll make them feel guilty by wasting the car dealer's time. Or maybe people can't remember more than two experiences. We really don't know.

So for us here, the interesting question I think is not rationality or irrationality. It's really the effort to find out what people actually do, to try to identify the repeated common biases in decision making and just work with them for what they are and then find ways to use data to address them for the good of the decision maker without worrying so much about whether it's rational or irrational. And here's why, at least from my perspective, this is deadly serious stuff. So just imagine you have two identical cancer patients who walk onto your oncology ward. And they're going to have to make a decision about whether they are going to agree to a new experimental treatment that you're going to offer them. So one person is told by her doctor-- let's say, me-- that she will have a 90% chance of surviving the treatment. That's what I say to the first person. Then I say to the second patient with exactly the same disease that the treatment she's going to get has a 10% mortality rate-- so on the one hand, 90% chance of surviving and on the other hand, 10% of dying. One of these people is going to say yes to the treatment, and one of them is going to say no. So who's made the right choice? Who's made the rational or best choice? That's not what we're really after here. This is too important for arguing about that. This is literally a matter of someone's life and death.

And so from my perspective, this is just a huge opportunity for data scientists and data. It's not likely that data by itself is going to overcome really big decision biases in most instances, but I'm quite confident that the right data presented in the right way at exactly the right moment in a decision process just might make a big difference in a decision like that and actually might save people's lives. But what I think is certain is that there are going to be lots of experiments coming in the next few years to try to identify and make more precise these really valuable windows of opportunity, both when it comes to individuals making decisions about whether or not they should have a cancer treatment or a business making a decision about whether or not it ought to make a new kind of widget. So let's start doing some of those experiments now.

10.3 Biases in Decision Making, Part 3

There are literally tens, maybe hundreds of common decision biases that individuals fall prey to all the time. And we can't counteract all of them. But we can work on

counteracting the most important ones. So let's discuss a couple of the common ones, the ones that we see all the time in our daily lives. And oh, by the way, the ones that all of us do, even though we try not to do it. We're all subject to it. The challenge is, how are we going to fix this stuff with data? So let's take the most obvious one, the one that even though we know we shouldn't do it, and we're all scientifically trained not to do it, we do it. And it's called confirmation bias. It is the most familiar, and it's actually sometimes the most insidious one as well. It's about the human brain doing exactly what the traditional scientific method tells us we should not do. Instead of doing what we should do, which is seeking out evidence that would falsify a hypothesis that we hold, we tend to seek out and pay greater attention to the evidence that supports our hypothesis, that reinforces our assumptions, that make stronger our prior beliefs. It's like the internal yes man that just wants to believe.

So let me give a concrete example. I have this gut feeling today that the pain in my knee is arthritis. I don't know what it is, but I have this gut feeling. That's my hypothesis. So I'm going to go through the week and I'm going to pay particular attention to the days when it rains and my knee hurts. And I'm just going to downplay the times when it just so happens that it also hurts when it happens to be sunny out there, because that evidence probably just doesn't matter as much. Or people make this mistake in finance all the time. I think Apple is a great company. And I think its stock is way underpriced. So when I walk into an Apple store, what am I going to see? I'm going to see all the beautiful devices, and I'm going to see all the people playing with those beautiful devices. And I'm going to completely ignore the fact that nobody actually seems to be buying anything. Or I'm running experiments in my lab and I'm cherry picking data. Now that sounds like a really bad thing to do, and it is.

But let me give you the classic example. I might write a paper where I mention a statistically insignificant effect, as long as it happens to be heading in the direction that I want it to go. But I might not mention an equally insignificant effect that happens to be heading in the wrong direction because of my hypothesis. And you've all seen this in scientific papers. It's a very common thing. Look, a couple important points about this. Confirmation bias is confirmation bias. It's not intentional. The biased person is not consciously trying to mislead himself or mislead others. If you're doing that, it's called lying. It's not confirmation bias. Second important point, there's a bunch of stuff going on here. It's probably a mixture of what psychologists call hot elements and cold elements. Cold elements are the cognitive information processing mistakes that people make. Hot elements are the emotional motivated mistakes. So a cold confirmation bias is just sort of focusing on the positive reviews of a movie that I really want to see, and not paying attention to the negative ones. That's just cognitive misprocessing. A hot confirmation

bias, I'm watching the 49ers play the New York Giants. I've been a Giants fan my whole life. So I'm going to pay attention to how many penalties the 49ers get for unsportsmanlike conduct, and how many turnovers the Giants defense forces, but I'm not going to pay so much attention to the opposite. And finally, this stuff can be strongly embedded in the self-image of the decision-maker. So I think of myself as a friendly person, who other people tend to like. Or I wish I was. But when I go to a party with a bunch of strangers, guess what? I'm going to focus on the fact that four people stayed and talked to me for a while, but not the equally salient fact that 36 people walked away from me within two seconds of shaking my hand, because it reinforces who I think I am. Confirmation bias.

How are we going to fix something so deeply embedded? Let's talk about a second one, splitting and bolstering. Complicated phrase, simple concept. It's really, really common, and it's really important in business decision-making. I'll start with an example. So I'm going through a midlife crisis. And I really need a convertible sports car, as any midlife crisis male needs. And so given my massive academic salary, naturally, my choice is between a Porsche Boxster and a BMW Z4. So how do I know which one to get? I read the reviews, I test drive the cars, I ask everyone I know. And actually, the decision is really close. They're both great cars. They're different in some ways. I go back and forth, I can't decide, I can't decide, I can't decide. And then I decided to buy the Z4. OK, now ask me a week later, and here's what I'll tell you. It was a no-brainer. The Z4 is much better on almost every dimension, although I know it's not. What am I doing? I split the alternatives and make them seem more different than they really are. And then I bolster my own choice, making it seem much more dominant than it really was. Classic example from a couple of weeks ago, Kennedy deciding between the surgical air strike and the Naval blockade. Very close decision. But afterwards, he thought the Naval blockade was absolutely the right thing to do.

Really common example in the corporate world, we've all seen it in mergers and acquisitions. Should Google buy Nokia or should Google buy Motorola? Comparable in all sorts of dimensions. And then the corporation decides to buy Motorola. And then the acquirers bolster the decision. They start telling themselves how the cultures of the two companies are compatible or nearly the same, despite the fact that before the acquisition process, everyone would have laughed at that proposition. And despite the fact that all the data says that big acquisitions of companies generally fail. Why? Precisely because the corporate cultures are so incompatible. So a quick comment, why do people do this? Some psychologists think it's just an effort to reduce cognitive dissonance. You don't want to go back after you make the decision and think about the dimensions that would have favored the other decision. You don't want to look back. So

it reduces stress and reduces the discomfort that would come with that. I don't want to feel that tug of uncertainty in my gut every time I drive by a Porsche Boxster in my Z4. I want to feel superior and absolutely certain that I made the right decision. Some people also think it's an effort to reduce the appearance of ambivalence. And a lot of people think ambivalence can be really detrimental to leadership. So if you think that people really lower down in the organization, really want their leaders to be decisive, and to provide certainty in what are really actually very uncertain situations, maybe that's one of the primary functions of leadership, then splitting and bolstering by leaders makes a lot of sense as a management tactic. Imagine how the American public would have reacted if George W. Bush had stood up on TV and given on the one hand a list of reasons to invade Iraq, and on the other hand, a list of reasons not to invade Iraq, and then told the country that on balance, he thought it was a better decision to be made to invade, but just barely, and he still had a lot of doubts. It sort of doesn't work in politics, and it won't work in most high stakes business situations. So let's turn to the Flick book and look at a couple of other really common biases as well.

10.4 Common Biases Overview

10.4.1 Common Biases Overview

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10.4.2 Self-Serving Bias (SSB)

- SSB is a special case of the fundamental attribution error in which individuals who are confident in themselves tend to attribute their successes to personal skill and their failures to bad luck or someone else's mistake.
- Low-confidence individuals often make the opposite attribution.
 - Example: a self-deprecating saying in the intelligence community: "In Washington, there are intelligence failures and policy successes but never the opposite."
- SSB has cold and hot components:
 - Hot (emotional): enhancing self-esteem
 - Cold (cognitive): enhancing the individual's sense of how much control they have over the situation

10.4.3 How Self-Serving Bias (SSB) Surfaces

- There is some evidence that SSB is slightly more prevalent in men than in women, and slightly less prevalent in older than younger people.
- This tracks with conventional intuition but probably should not be taken too seriously in most corporate decision-making environments, where selection bias may easily overwhelm these differences.
- Another interesting area of research is in how computers are treated.
 - If the computer is the counterparty to the individual in a decision situation, does the individual tend to differentially take credit for success and ascribe the blame for failure to software?

10.4.4 Ambiguity Effect

- Particularly in situations where some decision options have much better models and information attached to them than others, there is a common bias to prefer options that have more precise probabilities over those for which the probability of a good outcome remains unknown.
 - This can be consistent with measures of subjective expected utility but also may not be.
- The colloquial expression that captures this bias is roughly: "A bird in the hand is worth two in the bush."
 - In formal terms, this may not actually be true, particularly if the probability of catching a bird in the bush exceeds 50 percent.
 - It's when the probability of catching the bird in the bush is unknown, and/or when the number of birds in the bush is unknown, that the ambiguity effect is typically most visible.
- A rational decision maker would be willing to invest a certain amount of effort in searching for information or models that can provide a probability estimate to the ambiguous option, so that it could then be weighed on a level playing field against the more well-understood option.
 - Data scientists might very well expect to be called in to do this work, though the ambiguity effect suggests that they will be called in less frequently than they should be.

10.4.5 Endowment Effect

- A rational decision maker would not change his or her level of desire for something as a consequence of whether he or she already has or does not have it.

- Put differently, your willingness to pay for something you don't currently have should precisely match the price you'd be willing to accept to sell the same thing if you currently had it.

10.4.6 Endowment Effect vs. Reality

- This is not how most people act in practice, in part because of loss aversion (the phenomenon where people experience the negative impact of a loss as greater than the positive impact of an equivalent gain).
- An endowment effect kicks in once you believe you own something.
- You will find it harder to part with what you own than to acquire the equivalent thing if you don't own it.
 - Thus, you will demand a higher price to sell than you would pay to acquire the exact same thing.
- Mergers and acquisitions negotiations are a classic example of where this bias might come into play.
 - Some potentially value-creating deals will not get done if the endowment effect is big enough to matter.
 - Issue: Can data scientists intervene to help decision makers become more fully aware of this bias, its impact on markets, and potential ways to compensate for it?

10.4.7 Hindsight Bias

- Anyone who claims to have "known it all along" or has ever played "Monday morning quarterback" is intimately familiar with hindsight bias: the mind's inclination to interpret events that happened in the past as more determined and/or predictable than the same mind would have interpreted them before they happened.
- Social psychologist Phil Tetlock once captured this succinctly by saying, "What yesterday was completely unpredictable, tomorrow will be seen as having been overdetermined."
- Decision makers and those in positions of greater authority and responsibility often suffer deeply from this bias.
 - They do so particularly when others "got it wrong," and they think, for whatever reason, that they would have "gotten it right" (the essence of the Monday morning quarterback phenomenon).

10.4.8 Hindsight Bias Consequences

- Hindsight bias obviously can have pernicious consequences for leadership and for organizational decision making, but it is probably most damaging in its consequences for individual learning.
 - How does a decision maker learn from others' mistakes and failures (usually the most efficient way to learn) if they're certain they would never have made the same mistake?
- Hindsight bias can be a significant impediment to understanding and incorporating into decision makers' minds the results of carefully designed experimental studies.
 - If you can't convince the person using your research that the probabilities of different possible outcomes of your experiment are not tilted toward the outcome which the experiment actually yielded, then your strategy of experimental controls will not work well in practice, and they may very well underestimate the significance of your findings.
- Managing hindsight bias, at the simplest level, would be helped by maintaining, in the decision makers' minds, an appropriate understanding of the contingency of outcomes, even after that contingency has been removed by recorded history.
 - It's a problem that mystery novel and movie script writers encounter just as much as experimental researchers.

10.5 Bias Interview

Interview with **Jeff Zych, Optimizely**

Bias Interview

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Welcome. Building on our discussion of biases, we're going to talk today with Jeff Zych from Optimizely who is working on the web application of A/B testing and biases in user testing. So Jeff, could you tell us a little bit about your background, how you got to work at Optimizely and what it is you actually do there?

Sure. So, yeah. I work at Optimizely, an A/B testing company. I am a front end developer there. So I'm generally in charge of the website, optimizely.com, and I make

things that designers design. And part of that is doing actual A/B testing because everything that we change we want to test to make sure it actually has some sort of positive effect. If it doesn't, then we're probably going in the wrong direction and to change something.

So prior to Optimizely, I was at the School of Information, getting my master's in Information Management and Systems. MIMS, as they call it. And through that I was interested in the design and development of applications, and that led me to A/B testing to get data behind designing applications.

So Jeff, some people don't know the theory behind A/B testing, or even exactly how it works, or why it's important, and why it's so valuable. Could you just describe for us what A/B testing is really about and what you guys are trying to do with it?

So A/B testing is a way of getting data around why changing your website makes a difference. And it's a way of measuring that, really. So in the olden days, you made a change to a website and you would just do it, and you won't really have any data or insight into if it made a difference.

But what A/B testing lets you do is you have an original version of your page, and then you make a second version of it that has different texts, or different buttons, or a different layout, or something. And then basically you measure those two against each other. So half the traffic sees the first version, half the traffic sees the second version. And then you measure the difference in what they do.

And so usually you have certain metrics that you care about, such as clicking a button, or buying some sort of product. And you can see people that look at version A, are they more likely to buy this product, or are people in version B? And that gives you really powerful data to see if your changes are actually having a positive impact, either on your business or whatever your key metrics are.

So sometimes these changes can be really quite trivial visually. Like the difference between a red button and a green button, or maybe a big radio button and a square click thing, through thing, or something like that. How do you even know where to start in terms of what's the A and what's the B?

Yeah, so there's a lot of different starting points. And I will say a lot of companies and people have no idea what they're doing, and they all come to a product like Optimizely and they start randomly changing things. That is really a bad way to go.

Another thing that we do a lot is just like design wise you can say, aesthetically this is more pleasing to me, and you can start testing some of those changes. That, once again, is kind of a weak form of testing.

The aesthetics of one person might be really different from the aesthetics of another person. There's really no systematic rules around that, are there?

Yeah, exactly. And you're not really thinking very deeply behind why you're making a change beyond just the surface visual level. The bigger ones, like you and I have talked about before, behavioral economics, that is something that can give a lot of insight into why a change will make a difference. And so behavioral economics is a study of why people make decisions, and especially emotional decisions or decisions that seem irrational.

And this can lead you to theories of testing. So you can say, if I changed whatever the default option is, then people are more likely to go with that. And that can lead to some really powerful data and insights that you wouldn't get just from changing things randomly or changing the visual side of things.

So let's take a really concrete example. It'd be really easy on a web page asking for donations, for example, for a nonprofit or philanthropy. Forme to make 100 different levels of donations. I mean, it's no harder to do that than to have 50. But when you go to the web, typically, they're usually maybe four or five radio buttons, and then another. Why is that?

Yeah, so this is something, once again, in behavioral economics they have this idea of choice sets. And the basic summary of it is that people will get overwhelmed with too many choices, and they all kind of get paralyzed with choices, essentially. It's like when you go to the grocery store and you see an aisle full of toothpaste and you're like, I don't know which one to choose. They all look the same to me.

And so this is why donation sites will have only a limited number of options. So people will be more likely to choose one instead of getting paralyzed by the choices and not choosing at all, and then leaving your donation. So

You're essentially trying to be constructively biased in a way, in the sense of helping people to make the decisions that they want to make, but in a way that benefits your client with some kind of predictability about the population of people who are going to come to that website. At least many of them or some of them are going to be more attracted to a certain number of choices or certain color of button. Do you have any

sense of how you guys think about segmenting the population? I mean, surely not everybody prefers the same color or the same number of choices.

Yeah, absolutely. So that's actually kind of a big shortcoming with A/B testing these days is that there's not enough way of targeting different populations. And there are rudimentary ways of doing it. But the biggest thing we see is people will run A/B tests and then after they get the data, they will start segmenting it. After the fact, essentially.

And then they can go from there and try to figure out how to better each different audience and different classes of users. But it's definitely something that is very nascent right now, and it's very encouraging, and it's kind of what we want to move towards. Is having people get more personalized experiences on the web, and be able run A/B tests that specifically target different types of audiences.

I could say that Amazon is actually a really good example of someone who has a very personalized experience. So when you go to amazon.com, if you ever shopped there before or even really looked at the site before, they all start having recommendations on their homepage of things to buy that are similar to what you looked at or what you bought before. As opposed to just giving everyone the exact same experience, saying like, here's a Kindle. Buy these Kindles.

So that's something where they are extremely, extremely personalized in their targeting of people. And that is something that I know they do A/B testing. I'm sure they have tested what to show different people at different times and how to increase people buying products from them, essentially.

How efficient do you think A/B testing is as a method of targeting website attractiveness to people? Does it work well? Is it expensive? Are There are better ways to do it that would be easier, cheaper, and faster?

What do you mean by website attractiveness?

Well, the desire of someone, say, to make a donation, or click on a sale, or follow through in filling out a form, or something like that.

Yeah, so it's a really great way of doing that because it's something that is typically fairly easy to set up. But you get lots of data because lots of people are using your website, well hopefully. But basically every visitor is a data point that you can view.

And so it gets you a lot of data, and the counterpoint to that is something like qualitative research where you're actually going out, and talking to users, and seeing what they do

on your website. And that's the classic user research. They're different types of data, but this is a very cheap and efficient way of getting lots of data around very specific questions.

So you've been doing this work now for some time. And in some sense, you had the privilege of having access to this just enormous database of human biases and the ways in which people differ in how they interact with a physical or visual interface on the web. What's your gut telling you what do you know about the biases that you feel are probably the most well visualized? What is most experienced by people when they're interacting with websites? What's your gut?

Yeah.

What really matters?

What really matters? I would say what really matters is really just focusing on your website, on your message, your call to action. Those types of things. Because the biggest thing that we see is people have these really cluttered pages. People get distracted very easily.

Yeah, we know that.

We know that. And so one of the jokes we've made is that we've talked about having an automated test suggestor. That's kind of some holy grail. But the joke we make is we can just do something where we just remove elements randomly from a page, and that's probably better than any other tests they could run. Because that will help people hone in on a page that is focused down to the core on what you want it to do. So for clicking a button selling a product, you hone it down just to that very specific task and you make it very efficient at that.

Just a couple more questions. Do you have designers that are traditional. The people who think of themselves as design thinkers working your company, and how do they interact with the hardcore data people who are really doing the analysis of the A/B test results? Is there good collaboration between those two different ways of thinking, or are they in tension with each other? How does that work?

Yeah, we do have designers, of course, doing a lot of visual design. And they are very data-driven. As a company, it's kind of ingrained in our culture. And whenever they're designing something, they're really good about thinking, how can we test this? And part of that is also that's part of my job too. I work very closely with the designers, and so

when they are proposing a design we will be thinking, OK, well how can we test this? How can we prove that it is essentially a good change?

And it's interesting because there has to be a balance there between a designer's intuition, and their gut, and what they think is good, and what's good for the business. Because what happens with companies like Google who have a tendency to over test things is designers can get frustrated with having to prove that what they're doing is right when you can't necessarily prove everything in design is actually better for one reason or another.

Some other things purely just look better and they don't necessarily convert better, if you will. But in general, to answer your question, our designers are very good about thinking with data, and thinking about how they can prove that their designs are better in some way.

That's very interesting. The concept of over testing. Actually sometimes more data is not always better in a setting like this, and a little bit of intuition aesthetics can be worth its weight in gold.

Yeah, exactly. It's actually a really interesting story around Google. There was a very high profile designer a few years ago who left. The story was they tested 41 different shades of blue. And from his perspective he was like, well, I'm the designer. I shall choose the blue that I think is best, and testing 41 shades of it just took away all his agency and his creative freedom.

Does that have anything to do with that 41 shades of gray or 48 shades of gray?

A little different topic here.

So lastly, Jeff, if you think about the kind of trajectory of A/B testing and its relationship to, say, the theory of how people make decisions and biases and stuff like that, where do you think this is going over the next couple of years? And even beyond that, what do you think your grandchildren are going to say when they look back at what you're doing today?

Yeah, so I have a few different thoughts on that. First of all, I think the web of today is something that's pretty impersonal. And this kind of relates to Amazon. Amazon is good at making very personalized experiences where everyone sees a different home page. Most sites though everyone's seeing the same thing.

And A/B testing plays into that because really what you're doing is you're kind of making an average best site. So your theoretical average user is having the best experience. But that doesn't make the best experience for every user that's coming to your site. And so I think it's getting more personalized. I think testing is going to lead towards that. So that's one thing.

Another thing is that our world of today has many devices. We are using our computers, our phones, our tablets to browse the web and interact with data and the internet in a lot of different ways. And so one thing we're certain to hear from clients is that they want to be able to run tests essentially across these devices.

So if you're a company like CNN, you have these articles that you're publishing. And maybe you're going to test the headlines to see which one more people click on. That's something that you can run on their website, but maybe someone goes back to their phone and they're looking at your site, they see something different. And so they want to be able to both have tests that run across these devices, but also they want to be able to track people across devices.

So let's say you're looking at a website on your phone, and maybe you don't buy something on your phone. You come back later on the laptop, and then you buy something. That kind of interaction isn't captured in A/B testing today because you can't track across devices. But it's something that's really valuable data that companies would love to have. But the tools of today are a bit too rudimentary to do that type of testing.

Thank you, Jeff.

Thank you, Steve.

Thanks for coming.

My pleasure.

10.6 Make Choices Consistent With Interests

So what I'd really like to do here is try to summarize and really highlight what we think are really the most important takeaways from this discussion about biases. And as we said-- and it's actually really important to remember this deeply-- biases aren't good or

bad. Even though they sound bad, they're just what they are. And sure, people are going to continue debating why they happen, and I think that's useful but only insofar as it helps the rest of us figure out what to do if we want to counter or modify those biases in useful ways. As I said, I don't think it's terribly interesting for our purposes as data scientists if it doesn't do that or if the debates are sort of trying to route those biases in evolutionary or development stories.

Lots of people are very interested in what people talk about as the negativity bias of the brain, how you tend to remember bad things more easily than you remember good things. And anyone who's ever had a really bad day will know that. That negativity bias probably helped lizards survive in the prehistoric era, but it's stuck in our brains now. We don't really need it. All we need to do is try to get better at making the decisions that are actually consistent with our interests. And that's why I say it's not about rationality versus irrationality. That's somebody else's argument. And in fact, if we get too involved in it, it becomes a kind of normative bias in and of itself, where particularly if you're dealing with technically and scientifically minded people, we're going to naturally sort of think, OK, rationality is good. Irrationality is bad. And that's actually not going to help us when we're dealing with real people. Here's what this is about. We're trying to help real people make better decisions, which to my mind ultimately means choices that are more consistent with their own interests and really choices that they're less likely to regret later on.

And I think the same is really true of organizations. Esther Dyson, who you probably know-- she was the founder of Release 2.0. She's actually the daughter of the physicist Freeman Dyson. She once said something really profound, which was simply, "Make different mistakes." Here's the problem with biases. The biases tend to drive people and organizations to make the same damn mistakes over and over again, and that's what we really want to try to counter.

10.7 Biases in Action

Overview

Spend five minutes on the following prompt:

Identify one bias you regularly observe. What is the bias? What are the consequences? What is one way you may be able to mitigate the bias?

10.8 Dead Conventions

We're going to spend some time now talking about, what I like to call, dead conventions. And let's start with the word "convention" as in kind of conventional. What do you think about when you hear it? A routine, something that's expected, maybe a psychological schema or a way of doing things that's just the way we do things because, after all, that's the way we do things and nobody really questions it. That's what I think of when I talk about conventions. And every moderately complex social system, whether we're talking about a country, a society, a business, a family, if you kind of step back from it, is just filled with conventions that nobody ever really questions. So I don't know, a personal example. Sunday night at my house, I just take out the garbage. And my significant other cleans out the refrigerator. We've never actually agreed on that division of labor. We've, in fact, never even discussed it. Probably, we just kind of landed on it, some time, some years ago. But if somebody asked us, why do you do it that way, nobody in that house would really be able to tell you. No one could even remember why we started doing it that way. And actually, now, we don't even think about it. It's just actually a convention. And we don't even recognize that it's there. In fact, the only way we might recognize that it was even there as a convention is if something happened that made it impossible to fulfill. Like let's say she breaks her right arm this weekend playing football and can't reach the top shelf of the refrigerator anymore to throw out the rotting food that's up there. And then, one of us might actually ask, wait a minute, wait. Why are you doing that and me taking out the garbage? Or maybe we should play around with this and try to do it some different way. More likely, actually, it would take an outsider, someone from the outside who just sort of rockets in to evaluate what we're doing to actually see the convention as a convention and even imagine that it could be re-evaluated. So imagine an extraterrestrial creature from a matriarchal society lands in my house and watches what we do. That person is going to probably see a convention. Or it may be more likely, a McKinsey consultant, whose job it is to re-engineer our domestic production systems for maximum efficiency at home, might come in and do a time study and watch what we do and then hand us a huge expensive report that proposes that I do both of these jobs. That I do the rotten food and the garbage and that she, on the other hand, be tasked to feed the cats. And in fact, now that I think about it and I unraveled the convention, I can tell you that this would definitely be a more efficient division of labor. And still, think about how hard it would be to actually change that behavior. It might take us weeks or months. In fact, we might not even do it even though we've decided it's a convention and we want to change it. That McKinsey report might end up on the shelf. Because conventions really are like muscle memory in the mind. You do them without even knowing that you're doing them unless you're from the outside. So let's take a look at a classic one. Here's a photo of a Civil War cannon reconstruction. It's taking place at a park in New Jersey. As you can see, there's a camera person there filming it. So this isn't a real Civil War. This is a bunch of Civil War

enthusiasts who want to spend their weekends in New Jersey pretending like they're in the Civil War. But if you look really closely at this picture, it's pretty clear what the guy standing behind the cannon is going to do. What about those two guys who are standing at the front of the cannon in this very formal pose with their kind of rods? What actually are they doing there? Why are those gentlemen standing there? Well, think about it for a minute. Where did that cannon come from? Cannons are rear-wheel drive. So they're not pushing the cannon. You don't see people pulling the cannon. Actually, it's just a dead convention. The reason they're there can be seen by looking at this other picture. Here's why they're there. Because the people who later became the kind of stewards of the cannon earlier were the people who used to lead horses around. And horses are essentially front-wheel drive. And if you stand behind a horse and try to push him, he's not going to go the direction you go. But if you stand in front of him and walk alongside him, then the horse will move with you. And when those people were later tasked to become the stewards of the cannon, they just stayed there as if that was the natural thing to do. That's a classic example of a dead convention. And boy, if you haven't seen them inside the business or the organization that you work for, go look. You'll see literally hundreds of them. In fact, culture is kind of filled with dead conventions, including corporate culture of course. So let me give you some examples of classic conventions today that are dead conventions. But you'll see how your mind immediately makes it look as if they're real. So imagine a photo of an office. And someone is sitting in the large corner office. That person must be powerful and is probably the boss, right? Well, that's kind of a dead convention now in the 21st century. Or a 25-year-old man is seen in a picture driving away for the weekend with a 25-year-old woman. I grew up in an era where that suggests some kind of sexual relationship. But that's a dead convention today. They just might be going away for the weekend to be hipsters together. Or a 40-year-old housewife born in the United States, whose parents were also born in the United States, speaks fluent Russian and Chinese. Well, she must either have extensive ties with some transnational company, or she is a spy. That's a dead convention. Look, a couple of really obvious examples to demonstrate that, when people break conventions, it can be truly profound. It doesn't just sometimes change a company. It can actually revolutionize an industry. So think about everybody's favorite example these days, Apple Computer. Apple Computer is a company that broke conventions all along the way of its development. I'm just going to point to one. In the early days of Apple's development in the 1990s, those of you who remember who may have used Apple at that time will remember something called system 7.5 as Apple's operating system. It was a terrible piece of software. It crashed all the time. And those of us who were Apple fans were just enormously frustrated with this really bad piece of software. But Apple was built around the idea that it had a unique operating system that simply had to be proprietary. And that was the only way it could

survive in a market that was dominated by the behemoth, Microsoft and Intel and IBM. Well, Steve Jobs came back to Apple in the late '90s, early 2000s. And he just turns this upside down. He came, as you probably know, from NeXT Computer where he had been working with an open source operating system that was based on BSD Unix. And even though the convention, the deep belief in Apple, everyone knew it to be true, that Apple needed a proprietary operating system was the logic of their business, Steve Jobs just turned that upside down and blew it up. And he built something called OS 10, or what's now known as System 10, built around the BSD Unix core. And interestingly, this accounts for at least part of Apple's extraordinary success going forward. They were able to port the key elements of that operating system from the desktop computer to the iPad to the iPhone to the iPod because of the open source character of the underlying code. It's part of the story about why Apple has been so successful. But even more important, it set the stage for operating systems to be open source in large parts of the industry. And arguably, the entire industry of the PC is eventually going to move that way. Think about Android as the mobile operating system. Let's take one other example. My favorite. Here in the United States, HBO. HBO is a company that revolutionized the television, and I feel like the movie industry as well, by breaking core conventions about what everybody knew was true. 15 years ago, I used to go to the movies. I never watched TV. And if you worked in Hollywood, it was certainly the case that the serious people-- the really good actors, the really good writers, the serious directors-- they wanted to work in movies. And TV was kind of for second-tier people. It wasn't that interesting. It was about making money but not about making really excellent content. And everybody sort of expected that and knew that that was true. That was the convention. It was really based on this deeper belief that the audiences, the people who turn on their TVs, don't really expect much from their TV. They sort of expect to see something that is just barely preferable to watching a blank wall. And anything beyond that is kind of a pleasant surprise. Well, HBO sort of turned that on its head and decided that it was going to produce a very different kind of content, a very expensive kind of content. A content that was actually demanding more from its audience than probably any television network or television show had ever done in the past. Content that actually required people to think and to remember and to struggle with complicated plot lines and really complex ethical arguments. Well, let's fast forward 10 or 15 years. Here we are in a world, at least in the United States today, where TV has become unbelievably interesting. People are actually now talking about the golden age of television or the Renaissance of television. And it's much more interesting now for many people to work in the TV world than it is in the movie world because they actually have more freedom of expression, more time to develop characters. A broken convention that has fundamentally changed an entire industry. So HBO truly broke a set of conventions about content, the television industry, the movie industry. And in doing so, it didn't just

innovate for itself. It actually revolutionized the entire content industry in a very significant way. And here's the thing. Those conventions are really, really sticky. Eventually, they become dead conventions. And sooner or later, someone sweeps them out of the way. But it's almost never the case that a convention goes away easily. And it's almost never the case that really compelling data, in and of itself, by itself, can wipe a convention off the face of traditional organizations. You got to think more broadly about how that data is going to actually impact the convention.

10.9 Similarities and Differences

Here's a small piece of advice that I think applies to anybody that comes into an organization and is looking to shake things up or really create innovation. One of the simplest things you could do is just walk around and look for the dead conventions. And look for them everywhere because actually, that's where they are. They are everywhere. One of the tricks that I sometimes use to try to seek out dead conventions in organizations, or really even in systems of thinking, is to remind myself that what's sometimes most interesting is not what looks different or not what changes, which is where we're attracted to as human beings, but instead, to focus on what people assume will remain the same, what won't change. So let's look at some classic advertisements that are fun ways to point out that constant. Here's a great advertisement for the Hoover vacuum cleaner in 1947, and look at what's changing in this ad. There's new furniture. There's new color drapes. There's new technology. There's both the stand-up vacuum cleaner and the roll-along vacuum cleaner. It's all about change, and it's all about revolution in home appliances. And take this ad. Again, this is about a new kind of soap for washing dishes and how it's going to allow people to wash dishes without chapping their hands. It's again, all about a new technology, something new, something exciting, something that people don't currently have that they're going to want to have. And here we are with yet another liquid soap, and interestingly enough, a scientist who is testing Liquid Chiffon to prove that it's as gentle as its name. And look at the scientist with the cool gentle meter which is going all the way up and proving-- scientifically, I might add-- that Liquid Chiffon is better in 1958 than any other kind of soap on the market. And then finally, my favorite ad of all, 1952-- Drano opening the sink, saving, clearly, in this advertisement not only a marriage, maybe an entire family from absolute destruction as a result of a clogged sink. Now look, these are wonderful advertisements if you can get past the absurd sexism of the period. What do they really point to? Again, you're drawn to what's changing. The technology is changing. The vacuum cleaners, the computers or the early computers that the Chiffon scientist is using, the chemicals-- new chemical science. The interested parties in the advertisements are changing. You've got

home-keepers. You've got friends who are looking at each other's chapped hands. You've got scientists. You've got husbands. You've got wives. The manner of presentation is changing. One of the ads is really about a scenario. One is about a cartoon. Another one is a narrative. The kind of emotion that the advertisement is trying to prompt in people is changing. One is about opportunity. One might be about fear. One might be about excitement. That last one is almost certainly about shame. But stop for a moment. What's really interesting is the assumption about what will remain the same, and it's so obvious. What you see is that the role of women is going to be exactly the same in the future as it is today-- in other words, 1952. That's the assumption about what remains the same. Everything else changes, but the woman's role doesn't change. That's crazy. That's not the way systems actually operate, right? This is just an assumption that's so deeply embedded in the stories that no one could even see it as an assumption anymore. It's a convention. And soon, if you're living in 1952, it's going to be a dead convention. Nobody was able to unpack the obvious logic that if housework got a lot easier and if women were ashamed in relationships because the drain was clogged, then pretty soon, those women were not going to want to be in that setting anymore and they were going to look for something more meaningful to do with their lives. And that's part of what led to the revolution in women working outside the house. The point is you don't see it unless you look for it, and organizations just hold onto this stuff in the form of these dead conventions. They do it tenaciously. Again, just imagine for a moment that you were going back in 1952 and you were trying to explain to someone through the non-contextual collection of data that women's role in the family was going to change. You wouldn't get very far at all with that. In fact, the convention will win out. On the other hand, if you own the context-- if you own the context and bring the data to it, you have a fighting chance of changing people's minds.

10.10 What Is a Dead Convention in Your Industry?

Overview

Spend five minutes on the following prompt:

What is a dead convention you observe in your industry? Describe it. We recognize conventions are difficult to change. That said, what changes would you recommend to this old routine?

10.11 Demonstrating Fallacies

10.11.1 Fallacies in Decision Making

This element addresses the following learning objective of this course:

- LO6: Navigate organizational, personal, legal, and ethical constraints to facilitate better decision making and improve communication.

We've talked at length about some dead conventions. And like I said, these are faulty assumptions. But the assumptions that are buried so deep within the paradigm or so deep within the way an organization thinks about itself that even getting people to recognize that they are assumptions is actually a real challenge.

Just again, imagine yourself as Steve Jobs coming back to Apple in 2000 and telling the management and the people around them that Apple is not a computer company. It's a media company. Imagine what people looked at him like when he said that.

Or here's another good example that we've all lived through. Imagine the first time an electric utility company tried to explain the concept of load management to its employees, the notion that we were going to pay people to not use electricity. That must have broken people's minds up a little bit.

Now, those kinds of things are really deeply embedded. But what we want to focus on now is the way in which those assumptions and the problems they cause actually get compounded by what people do with them by reasoning from assumptions. This is what I like to call "tempting fallacies of argumentation." Let me deconstruct that for you a little bit.

I think they're tempting because people want to do them, even though they may know it's wrong. The human brain just wants to draw inferences and conclusions that seem right but aren't actually justifiable. Think of optical illusions that we all know are illusions. But we still fall for them.

It's a little different from cognitive biases because these aren't just information processing problems like biases are. They're actually reasoning problems. They're reasoning processes that are just faulty. And it's different to change them.

In fact, there are so many logical fallacies, an infinite number of ways to get a reasoning process wrong. There are actually very few ways to get it right. What we want to focus

on are the more common logical fallacies, the faulty reasoning processes that actually impact our lives or organizations that all of us would almost immediately recognize if somebody pointed them out to us.

And actually, maybe we'd laugh at them, although I'll tell you, most of the time, it tends to be nervous laughter because we know we've fallen prey ourselves to these fallacies, even though we should know better. And thus we're a little bit embarrassed about it when we see them.

So what we're going to do here is be, again, really pragmatic and just try to focus on a couple of important tempting fallacies of argumentation that we think are most tempting in typical kinds of organizational settings. And actually, maybe those that we can imagine as being the most frustrating to a data science community, which is another way of saying, maybe these are the tempting fallacies of argumentation where bringing data science to the table could have the most transformational impact where we could really start to change things.

So let me talk through one here. And then we'll turn to a group to talk through about some others. These things, by the way, usually have complicated names. But they're simple concepts.

The complicated name for the one I want to talk about now is something called the "ecological fallacy." And probably some people have heard of it. But let me tell a story about how it actually works.

Everybody knows or most people have heard of, I guess, the category BRIC, B-R-I-C. It stands for Brazil, Russia, India, China. People talk about the BRIC countries or the BRICs as an investment opportunity. BRICs is now a category.

Now, here's where it becomes an ecological fallacy. India is a BRIC country. So if the BRIC countries are a great place to invest, as we're being told, then India must be a great place to invest. That's the fallacy. People make an inference about the nature of a specific case or a specific individual within a group of cases from aggregated statistics that are collected about the group to which that individual belongs.

Everybody knows it as soon as you see it. The aggregated statistics wash out a lot of the variation. But if you believe in the category and you believe in the statistics that attach to that category, you're much more likely to believe that that statistic or that

characteristic attaches to any individual that's gotten pulled out of that category and talked about specifically.

What we're going to talk about is, how common is a bias like this? Where do you tend to see it a lot? Where does it happen less and why? And most importantly, we're going to focus on, how can people try to counteract this fallacy and make sure it doesn't affect decision making?

10.11.2 Demonstrating Fallacies

This element addresses the following learning objective of this course:

- LO6: Navigate organizational, personal, legal, and ethical constraints to facilitate better decision making and improve communication.

Welcome. We're going to talk now with two students from the School of Information-- Jason, thank you. Sandra, thank you-- about these tempting fallacies of argumentation that we brought up earlier in this unit. And I just wanted to remind you that there are fallacies of argumentation, sort of a subtle difference. If bias is about how you interact with a piece of information, a fallacy of argumentation is how you reason from A to B or from A to C and how we often do that incorrectly.

So actually, you can have lots of biases and fallacies in the same mistake. But right now, we want to focus on the fallacies. And we also want to focus on the fact or remind ourselves of the fact that these are tempting things.

The problem with fallacies of argumentation is that the brain constantly wants to do them, even though we often know they're wrong. Now, in theory, there are, of course, an infinite number of ways you can get a reasoning process wrong and actually only a few ways you can get it right. But let's focus on a couple of fallacies of argumentation that seem to be particularly prevalent and really matter in decision making settings and particularly in business decision making settings.

So let's start with the one that every statistician knows and talk about how it actually operates, the ecological fallacy. The ecological fallacy, put really simply, is deducing the characteristics of, say, one member of a category from what you know about the whole ecology of the category. Jason-- story about where you've seen this and what it feels like and why you do it, even though you know you shouldn't?

One example I can think of is here in the Bay Area, it's a very wealthy area. There's a lot of people who have a lot of money, a lot of high average income in this area. And yet there are obviously people who are not as well-off here. So When you meet someone

who's from the Bay Area, you may assume that they are a high-flying tech person with a lot of money. But obviously, there's a lot of poverty here, as well. And so there's a fallacy where you're assuming something about that person based on the group that they're in.

Yeah, it's a classic one. People do it all the time. Sandra, any thoughts about what you've run into?

So I read an article recently about, well, females in STEM subjects. And it was--

So STEM is Science, Technology, Engineering--

And Math--

And math. OK.

So there is the understanding that there are fewer women especially in technology roles right now. And this lady who wrote an article was talking to a bunch of professors about this sort of subject. And I think it's really easy to say, oh, I had lots of girls in my science classes for high school or oh, there's lots of women faculty.

We just hired a female faculty member. We just admitted a graduate student who is female into our program. But That's one case, and because that's the one case you see, you sort of assume from there that just, oh, everything's must be fine.

Problem solved.

Yeah. And there was a really good line in the article where one professor said, scientists can be extremely unscientific about this sort of thing.

Yeah. It's actually kind of stunning. Those of us who are trained in statistics assume, at least in a formal setting, we would never make this mistake. And we probably wouldn't make that mistake in a formal setting, but in day to day life, we might make it all the time.

So I want to pose that question to the online student and ask you to just think back over the course of the last three or four days. You know you shouldn't make an ecological fallacy mistake, but I bet you have. So can you think of a time that you've done it?

10.11.3 Can you think of a time in the last several days when you or someone you know has fallen prey to an ecological fallacy mistake in a way that mattered?

10.11.4 Demonstrating Fallacies: Ecological Fallacy

This discussion focuses on manipulating the ecological fallacy, and the battle of the null hypothesis.

This element addresses the following learning objective of this course:

- LO6: Navigate organizational, personal, legal, and ethical constraints to facilitate better decision making and improve communication.

So I want to bring up one other example or kind of example about how people can sometimes manipulate the ecological fallacy to get others to do things they otherwise might not do. And when I say "manipulate," maybe I should say "influence." It isn't necessarily a terrible thing.

But the classic story-- everybody has heard the phrase BRIC countries, Brazil, Russia, India, China. You've heard it. And it's almost like you think of it as a category, like it exists in the world. Does it?

Well, obviously not. It was created by Goldman Sachs about 15 years ago, I think. So it's a common heuristic I think that people use to represent emerging economies or developing economies.

So let's tell the story about how it got created. There was a banker at Goldman Sachs who had some Chinese paper debt certificates, and he had some Brazilian paper. And there was a lot of demand for both of those, but he also had handsome Indian paper and some Russian paper that nobody seemed to want. And so he thought, well, if I sort of throw those all together and I create a category called BRICs, I can sell them all as one.

And so people started reasoning around that category like, well, if India is a BRIC country, then it must be growing fast. And its stock or its debt must be very, very valuable. And here it is. It's, as you say, 15 years later. How many times do you see the word BRICs used in the newspaper, in the financial press?

It's talked about all the time, and I think it is used as a shortcut. And when we're under pressure and we need to make decisions very quickly, we do fall back on these shortcuts. And it's very tempting, as you said, to use these reasoning fallacies, like the ecological fallacy and the BRICs.

Particularly when you don't know a lot about an individual case, you're more likely to just deduce inappropriately from the ecology that that case has some characteristics that it might not have, actually.

Well, one other element that happens here is sort of quite remarkable. You've probably seen any number of times over the last couple of years people just kind of reminding each other and themselves again and again and again that the emerging markets are differentiated from each other. This is not a real category. And yet people still use it. These Things hang on for a very long time.

So Jason, can you think of another example where this ecological fallacy commonly happens and matters to people's lives?

Well, I think one example is in health care, when you have a disease that, say, kills 80% of the people within x number of years, if you know someone who has survived that illness, you tend to think of them as an extreme outlier. But in fact, the 20% of people who don't die may have some other characteristic that isn't really attributable to luck. Actually, there's other scientific bases for why that person may have survived.

And even though we sort of know that-- again, every biostatistician knows this problem-- we make the mistake again and again. And if it was us sitting in front of the doctor telling us that we had this 80% chance of death, probably would not reason that out in the way that we'd really actually know we should.

Yeah, I think we would probably think of ourselves as part of the 80%--

Make the same mistake, tempting fallacies of argumentation. Let's talk about another one that happens quite frequently and that actually I think matters quite a lot, both in the public decision making world and in the corporate decision making world. And I like to call it the "battle of the null hypothesis," which is really the fight over who gets to say that something is true until it's proven wrong.

So the classic case I think of in the foreign policy world is going back to 2003 here in the US, we worked on the assumption that Saddam Hussein had weapons of mass destruction unless you could prove that he didn't. And that's why that null hypothesis won.

Donald Rumsfeld famously said in one of his great aphorisms, "The absence of evidence is not evidence of absence," which in a sense shows that he had already won the battle of the null hypothesis. In a lot of situations with great uncertainty, if you can

win the battle of the null hypothesis, you've won the argument. So any common examples that you can think of where that seems to actually really matter?

Well, I think in court cases, "innocent until proven guilty" is a great example of this. So if you are arrested for a crime, you are essentially legally considered innocent till proven guilty. That doesn't actually necessarily mean in the media, you are portrayed as innocent till proven guilty. Sometimes, a more popular opinion is, oh, he's definitely guilty. And Even if the court case cannot prove this, people will still believe it.

But we've decided constitutionally, at least here in the United States, that the burden of proof is on the prosecutor. So the null hypothesis is you're innocent, and it's actually the prosecutor who has to bring the data to the table to prove that you're guilty, whereas at least in some other societies, either formally or informally, you're guilty until proven innocent. So the burden of proof shifts to the other side.

And actually, that's probably a whole lot more important than, say, another bolus of data or another bolus of information about what actually happened in that setting. It doesn't always work perfectly, but switching that null hypothesis around is really, really impactful on what happens. Any other examples?

Well, I wonder if one example would be, say, Apple products. When Apple comes out with a new product, most people assume it's going to be amazing. And if it doesn't live up to their expectations, they wonder if maybe it was their fault that it's not as amazing or if-- so I think Apple has kind of won the battle of the null hypothesis when it comes to product development.

Interesting. So I'd like to pose this question back to the online student. The battle of the null hypothesis is something that is often tied to power relationships in decision making settings. You walk into a room, and someone has already decided what the decision is going to be in that meeting unless they are proven wrong. So can you think of an example in your work life where that's happened and it's been extremely frustrating and hard to overcome?

10.11.5 Can you think of a recent example when you felt like you had lost an argument because you lost the battle of the null hypothesis and thus never really even had a chance to make your case on a level playing field?

10.11.6 Demonstrating Fallacies: Counteracting the Null

This discussion focuses on counteracting the battle of the null.

This element addresses the following learning objective of this course:

- LO6: Navigate organizational, personal, legal, and ethical constraints to facilitate better decision making and improve communication.

So let me turn back to you folks and just ask you to think a little bit about trying to counteract this tendency. And Sometimes, it's a good thing. We've decided that we're innocent until proven guilty and we probably want to protect that null hypothesis, but there are other null hypotheses that we might want to change, actually, or attack the argument from the perspective of changing the null hypothesis.

Any thoughts on how people have done that? Or how you would imagine doing that?

Well, I think data is a good tool to present a fair and reasonable assessment of whether the null hypothesis is correct. But it can only take you so far, and when you have human beings making decisions, there are other factors at play such as their egos and other decisions, other contingencies in their own head. So data, I think, can take you part of the way there, but there is some argument that has to be done about that data.

So some people would say that this null hypothesis, once it's embedded in the room or embedded in an organization, is so deeply set in concrete, that you really have to shock things in order to change them. Like the shock value of an extraordinary piece of data or an extraordinary presentation at least has a chance of breaking that thing loose. Does that feel right?

I think it definitely helps to get people thinking of not the expected null hypothesis but possibly alternative hypotheses that you could consider as reasonable outcomes. And if you are so set on one thing, maybe this piece of data will get you thinking about something else. Get you going in a different direction.

So one of the challenges-- just to put it in a different language-- would be getting people to just put a question mark over what they think they know. Until you do that, really, you can't actually move them from point A to point B. Because they're just stuck in point A and no amount of evidence is going to counter the null hypothesis if it's really that strong.

Well, think about how to counteract that tendency and maybe we'll come back to it. Thank you.

10.11.7 The Powerful Anecdote

- A clever person once said, "The plural of anecdote is not data." But what he was actually trying to explain was something even more troubling:

- How a single anecdote, if powerful and emotionally resonant, can supersede an appeal to data, even when the relevant data are easily available.
- Another term for this fallacy is **misleading vividness**.
- *Common example:* People will make an argument about "how kids use technology" by telling a funny or cute story about their own child—a single case.
 - Given reasonable assumptions about the person telling the story in a business setting, it's quite likely an unusual case.

10.11.8 The Appeal to Novelty

- When everyone is seemingly obsessed with the notion of innovation, the appeal to novelty can undermine rational argumentation in insidious ways.
- The fallacy lies in claiming, implicitly or explicitly, that idea A is better than idea B because idea A is "new."
 - Interestingly, this operates at some tension with the "status quo" bias in decision making, where change is more difficult than stasis.
 - "New" is often interesting, exciting, and sometimes a little frightening, which can be a powerful attractor; defending the status quo can be interpreted as defensive or overly conservative.
- The fact that something is new is almost always immaterial to an argument about comparison of traits.
 - Obvious exception is markets where novelty is in and of itself a highly valued trait.
 - This is often used as a marketing argument in pharmaceuticals, for example.
 - Although as a patient, you might conclude that unless a new drug has better results and fewer side effects, you'd be better off taking the old drug, which has a larger body of clinical experience and evidence.

10.11.9 The Slippery Slope

- When people use the phrase "a tipping point," they think they've explained how a seemingly small or incremental set of causes can lead to what is labeled a big effect.
 - Much of this is rhetoric rather than logical reasoning.
- The "slippery slope" fallacy is closely related.
- Slippery slopes happen when a chain of seemingly related events, once set off by a small first move, inevitably or at least un-self-consciously unfolds and results in a significant effect that is generally undesired.

- Without specifying an underlying mechanism, slippery slope arguments are extremely suspicious.
 - They rest on a longer chain of logical relationships, with the assumption that no real breakpoints, thresholds, or decision points can be found along that chain.
- It can be an excellent rhetorical device in an argument, but it's most often not a defensible process of reasoning.
 - After all, even the "boiling frog" story is at best anecdotal; it appears that frogs actually will jump out of the pot when the water gets hot enough.

10.12 Bad Decisions Are Human:

Reference Video

At 2:06 in the following page, the professor pauses to reference this clip from *2001: A Space Odyssey*. Please watch it before you proceed. Think about any biases and fallacies of argumentation you observe. Think about how computers influence human decision making in the film clip and in your professional experience.

This element addresses the following learning objective of this course:

- LO6: Navigate organizational, personal, legal, and ethical constraints to facilitate better decision making and improve communication.

The sixth member of the Discovery crew was not concerned about the problems of hibernation. For he was the latest result in machine intelligence, the HAL 9000 computer, which can reproduce, though some experts still prefer to use the word mimic, most of the activities of the human brain and with incalculably greater speed and reliability.

We next spoke with the HAL 9000 computer, whom we learned one address as Hal. Good afternoon, Hal. How's everything going?

Good afternoon, Mr. Amer. Everything is going extremely well.

Hal, will you have an enormous responsibility on this mission. In many ways, perhaps the greatest responsibility of any single mission element. You are the brain and central

nervous system of the ship. And your responsibilities include watching over the men in hibernation. Does this ever cause you any lack of confidence?

Let me put it this way, Mr. Amer. The 9000 series is the most reliable computer ever made. No 9000 computer has ever made a mistake or distorted information. We are all, by any practical definition of the words, foolproof and incapable of error.

Hal, despite your enormous intellect, are you ever frustrated by your dependence on people to carry out actions?

Not in the slightest bit. I enjoy working with people. I have a stimulating relationship with Dr. Poole and Dr. Bowman. My mission responsibilities range over the entire operation of the ship. So I am constantly occupied. I am putting myself to the fullest possible use, which is all I think that any conscious entity can ever hope to do.

I've just picked up a fault in the AE-35 unit. It's going to be a 100% failure within 72 hours.

Is it still within operational limits right now?

Yes. And it will stay that way until it fails.

Would you say we have a reliable 72 hours to failure?

Yes. That's a completely reliable figure.

Well, then, I suppose we'll have to bring it in. But first I'd like to go over this with Frank and get down to mission control. Let me have the hard copy on it, please.

Well, Hal, I'm damned if I can find anything wrong with it.

Yes. It's puzzling. I don't think I've ever seen anything quite like this before. I would recommend that we put the unit back in operation and let it fail. It should then be a simple matter to track down the cause. We can certainly afford to be out of communication with the short time it will take to replace it.

X-ray Delta 1, this is mission control. Roger you're 19-er 30. We concur with your plan to replace number one unit to check fault prediction. We should advise you, however, that our preliminary findings indicate that your on-board 9-er triple 0 computer is in error predicting the fault. I say, again, in error predicting the vault.

I know this sounds rather incredible, but this conclusion is based on the results from our twin 9-er triple 0 computer. We are skeptical ourselves. And we are running cross checking routines to determine reliability of this conclusion. Sorry about this little snag, fellas. And we'll get this info to you just as soon as we work it out. X-ray Delta 1 this is mission control. 2049-er transmission concluded.

I hope the two of you are not concerned about this.

No, I'm not, Hal.

Are you quite sure?

Yeah. I'd like to ask you a question though.

Of course.

How would you account for this discrepancy between you and the twin 9000?

Well, I don't think there is any question about it. It can only be attributable to human error. This sort of thing has cropped up before. And it has always been due to human error.

Listen, Hal, there's never been any instance at all of a computer error occurring in the 9000 series, has there?

None whatsoever, Frank. The 9000 Series has a perfect operational record.

Well, of course, I know all the wonderful achievements of the 9000 Series, but are you certain there's never been any case of even the most insignificant computer error?

None whatsoever, Frank. Quite honestly, I wouldn't worry myself about that.

Well, I'm sure you're right, Hal. Fine. Thanks very much. Oh, Frank, I'm having a bit of trouble with my transmitter and [INAUDIBLE] pod. I wonder if you'd come down and take a look at it with me.

Sure.

See you later, Hal.

10.13 Bad Decisions Are Human

At this point, you must feel like I do a lot of the time. It's no wonder we want to take at least important pieces of important decisions out of the hands of human decision makers. Look at all the ways we get it wrong. The bottom line is it may be indelicate to say it this way, but humans just suck at decision making. And they suck at high-pressure decision making, and in some sense, the more important the decision, sometimes the more they suck. The point for data science really is it's not just for lack of data. It's not even because of noisy data. It's not just only because of bad data that humans make bad decisions. And it's not because only of the bias in how humans read data. And it's not even just because of the mistakes of reasoning, argumentation, and logic. The sad fact of the matter for human beings and for all of us, we suck at decision making because of all of these things. And as dysfunctional as all of those things are, you got to admit they're tempting for one or another reason. And human beings are not going to get much better at this anytime soon. I think this is actually why every generation wants to find some way to develop a kind of technological fix for this problem in order to take at least a significant proportion of these decisions out of the hands of the human brain. It could be the self-driving car. For earlier generations, it was advanced knowledge management systems. For even earlier generations, it was the idea of creating decision support systems for doctors who need to decide what antibiotics to prescribe. People are often uncomfortable with this kind of stuff, but they also really want to create it. And so it naturally becomes a really interesting theme in some of the great science fiction movies and novels of the last 100 or 200 years. So let's take a look at a quick video clip that many of you may have already seen from one of the truly greatest science fiction movies of all time, 2001-- a Space Odyssey. Let's see what HAL was designed to do and what he really could do. OK. So coming back from that video clip-- maybe having seen that, it's worth noting that the most important contribution I think of the work of a data scientist in the next generation is going to be to engage with and manage and maybe even defeat some of these tempting biases and fallacies of argumentation but most importantly, to reduce their impact on what human beings do and on organizational performance. Look, it's not going to be easy to do. Don't expect the brute force of data to do it. What we've got to do is think about working with the reasoning system, working with the social system, working with the business system within which data science is going to insert itself. We're never going to overcome it with sheer force of computational power and data.

10.14 The Rules of Inference

So I think the core solution to these fallacies of argumentation problem really lies in having some kind of an agreed set of rules or inference. It was obvious, if you think like someone writing, say, a body of software code or a statistician, here you have clear, simple, agreed, unambiguous rules for inferring, say, the cause of an effect, or a shared consequence of two causes, or the likelihood of a repeated event, or any other such conclusion that say, a health care professional or a marketer would like to be able to act on with some degree of confidence. You know what you're looking for. But the fact is most of the people that we have to work with don't actually have shared rules of inference. And this is even more true as we move into a period of globalization, where many companies are going to be combining managers, and workers, and senior execs from many different countries with different ways of thinking about this problem. And no matter how hard you try to teach them, you know, they're not, in the frame that we have, going to become really good statistical reasoners. In fact, very few CEOs will ever become statistical reasoners. That's not what they're paid for. And so I think this is one of those places where we kind of have to be modest, you know, firmly modest, but still modest about our ambitions. This is where we want to be able to identify a few important rules that we can clearly set down for business argumentation, and then try to render them in as simple language as we possibly can, and then cement them in the clients and customers' heads. That's where we're really going to get our greatest degree of leverage.

And so, again, when I'm looking for simplicity, I turn to the classic philosophers of causality for finding that. And I'm going to go back again to John Stuart Mill, who we talked about earlier-- in the 1800s, a British philosopher, economist, Politician. Mill laid out what are really four basic rules of inference. And they're very simple to see. And they're worth knowing and thinking hard about in practice. There was the method of agreement, the method of disagreement, what he called the joint method of agreement and disagreement, and the method of concomitant variation. You might say that's not plain English. And you'd be right. But we can actually work through them into very simple renditions of what they actually mean. So let's work through one of these. What is the core of Mill's method of agreement? Well, it's actually very simple. Think about it this way. If you have two or more phenomena, and they have only one circumstance in common, that circumstance alone, in which all the instances of the phenomenon agree, is a cause or an effect of the given phenomenon. Plain English, right? Actually, let's

render it in plain English. It's actually-- for x to be a necessary cause of y , x has to be present any time y is present. And that is true across a set of cases. Now let's render it in a simple practical example.

Here's the kind of problem that people get asked all the time. In the United States, there's a tax change on widgets today. There's also a really bad TV show that's for some reason and been very popular called The Blue Widget. And there's a health warning about the effects of the color blue on the propensity of people to get Alzheimer's disease. That's what it is in the US. In France, this year's fashions are just deemphasizing blue. Everybody hates blue. There was also a similar health warning about the relationship between seeing blue things and getting senile. And there's a major politician whose name sounds a lot like blue in French who was just recently arrested for having seven mistresses at one time. That's what happens in France. In South Korea, there's a new pop band named Blue Monday. There is a major newspaper that has just switched its headlines to Blue Ink. And there was a health warning about the color blue and senile dementia.

Here's the thing, you are working for a widget company. Your boss calls you into her office and she says, my sales people around the world are telling me they have seen a major decline in the demand for blue widgets. Can you please help me figure out why that is? So Mill's method of agreement tells you how to do that. But more importantly, it tells you how to explain to her why you've done that. From the data you have, the best conclusion and, really, hypothesis, is that the cause of the decline is the health warning about the color blue. It's what all three cases share. Here's the challenge, and here's what I'd like you to practice. Without getting into advanced statistics for the moment, how are you going to explain that phenomenon to your boss in a simple, compelling fashion?

10.15 Applied and Theoretical Examples of the Rules of Inference

10.15.1 Applied Examples of the Rules of Inference

This element addresses the following learning objectives of this course:

- LO4: Justify an analytic approach that informs decision making.

- LO6: Navigate organizational, personal, legal, and ethical constraints to facilitate better decision making and improve communication.

Let's think about an applied example of John Stuart Mill's four rules of inference. Let's take his rule number one-- method of agreement. If you want to claim that x is a necessary cause of y, that is, you will only observe y if x is present, then you must see x every time you observe y. Let's go through an applied example.

Let's say you claim that a PhD is a necessary cause of being a professor. If you claim that it's a necessary cause, then all professors must have PhDs. You must have x to see y. That is, you must hold a PhD to be a professor. And that may hold.

But having a PhD is not a sufficient cause. A sufficient cause is if you observe x, you will observe y. Here, that doesn't hold. Just because you observe someone with a PhD does not mean they're a professor.

Here's another thing to think about. In order for x to be a cause of y, x has to happen before y. Now, this seems intuitive, but it's not always very straightforward. For example, you may claim that an investor's attitudes may influence a CEO's behavior. That makes sense. And in this case, the investor attitude is the x, and the CEO behavior is the y. That attitude exists prior to the CEO behavior, and perhaps this example satisfies the requirement that x comes before y.

But you could come up with a different story. You could also think about the exact opposite, that is, that what a CEO does influences investor opinion. In that case, the y would influence the x. So there could be a much more complicated relationship than we initially posited. And so the punchline is, if you articulate a causal story, you need to be clear about the assumptions that are the foundation of your story.

10.15.2 The Method of Difference

This element will address the following learning objectives of this course:

- LO4: Justify an analytic approach that informs decision making.
- LO6: Navigate organizational, personal, legal, and ethical constraints to facilitate better decision making and improve communication.

The Method of Difference

"If an instance in which the phenomenon under investigation occurs, and an instance in which it does not occur, have every circumstance save one in common, that one

occurring only in the former; the circumstance in which alone the two instances differ, is the effect, or cause, or a necessary part of the cause, of the phenomenon."

—John Stuart Mill, *A System of Logic*, Vol. 1

Here, Mill is trying to isolate a cause or a partial cause of a phenomenon that is being compared with another phenomenon that has overlapping causes. A simple logical rendering looks like this:

A, B, C, and D occur together with W, X, Y, and Z

and

B, C, and D occur together with X, Y, and Z.

We infer that A is the cause, or a part of the cause, of W. This does not, of course, exclude the possibility that A is an effect of W.

The Joint Method of Agreement and Difference

"If two or more instances in which the phenomenon occurs have only one circumstance in common, while two or more instances in which it does not occur have nothing in common save the absence of that circumstance; the circumstance in which alone the two sets of instances differ, is the effect, or cause, or a necessary part of the cause, of the phenomenon."

—John Stuart Mill, *A System of Logic*, Vol 1

Here, Mill is applying both the method of agreement and the method of disagreement to the same investigation. The core notion is to compare a variety of situations in which a certain factor is present to similar situations in which that factor is absent, and then to show that a certain effect is observed in all and only those instances in which that factor is present.

The Method of Concomitant Variation

"Whatever phenomenon varies in any manner whenever another phenomenon varies in some particular manner, is either a cause or an effect of that phenomenon, or is connected with it through some fact of causation."

—John Stuart Mill, *A System of Logic*, Vol. 1

Here Mill is using covariation to assess causal connection. If we demonstrate that quantitative variations in an "effect" seen across a range of phenomena are systematically related to quantitative variations in a "causal" factor, then the effect can be associated with the cause.

Put simply, changing the magnitude of one variable changes the magnitude of the other, and the more broad the set of circumstances in which that relationship is seen, the better the inference.

10.16 Two Limits to Inferential Rules

Well with any simple schema, there are obviously going to be pragmatic limits to how far we can actually get people to agree. And so I just want to cite here before we end two really big, important limits on inference that are about practical statistical reasoning for the boss. JSM's rules are pretty good, but there are important limits that you somehow have to find the way to communicate with and around. So let me try to state them as simply as possible, the ones that really most commonly matter in a business setting. Here's the first one. John Stuart Mill, JSM, presupposes that actually we have a pretty good candidate list of causes that we want to consider. Or maybe a more precise way to say it is that our list of causes actually include the important cause of the driving force of the phenomenon that really matters. That in our list of characteristics say associated with people who get colon cancer, we have, in fact, on that list the oncogene that is the cause that actually matters. At least, if our boss is a pharmacogenomist. Now where does that list of candidates come from? It can come from many different places. It might be an informed guess again, it may be previous work, it may be history, it may be opinion. And it's OK. The system works as long as the cause we want is on the list. But the John Stuart Mill method of agreement does not, by itself, actually exclude the possibility that the list itself might just be wrong. Or more likely, incomplete. And so if we're missing the cause, if it's not on the list, then we hit a big limit to inference and we need to be able to talk about that.

Second big limit. John Stuart Mill presupposes that, at least for the practical purposes in which we're going to be working, we're going to be trying to tease out casualties that are relatively simple, that there's sort of one cause that we can isolate and describe as the big one that matters for the thing that we really want to do. So for example, the oncogene can be causally isolated. But what John Stewart Mill's simple rules don't do terribly well with is what statisticians call complex conjunctural causation, which is a terrible phrase but basically means when many things together cause, in conjunction

with each other, an outcome and maybe even on different time frames. So let's get back to the oncogene for a minute. The oncogene, the gene that is the source of the cancer, that might be what we call the tumor initiator. But you might want to also know about what people call the tumor promoter, the high fat diet, the low exercise lifestyle. The other things that happen on different time frames and function on different systems together to bring about the result that we're concerned about, which is the cancer. Now there's no guarantee that John Stuart Mill method is going to tease that one out. The classic examples that people talk about sadly, I mean, what causes suicide? The family that's left behind always wants to know the cause, right? The cause. And perhaps what they could have done to prevent it. But most suicide is almost certainly complex conjunctural causation. It's a combination of genetics, environment, exposure to social media, a drug interaction, maybe a bad social-- who knows. But it's a complex event at a particular time in a person's life. And that's hard to explain to someone who wants to know the cause.

Look, all of that is manageable in the realm of advanced statistics, and we're going to leave that for later courses. Our purpose here is simply to tee up the challenge of isolating and even more so explaining causation findings, and to put you in the shoes for a little while of those who you'll have to be explaining it to.

10.17 Expert Mind vs. Beginner Mind

Take a close look at the picture in this slide. What do you see? See an old woman? Do you see a young woman? Many people have seen this picture before, and so can you remember what it was that you saw the first time you saw it? And are you looking at the same woman now, or are you looking at the opposite woman? This is kind of a classic example of an optical illusion. And it's often used to explain the concept of an optical illusion to people. But maybe an optical illusion is not the best way to think about what's really going on here. It's definitely optical, but where's the illusion? There are patterns in the data in that picture, but both of the patterns that the minds interpret as an old woman and as a young woman are actually present in the data. It's not like one of them is an illusion and the other one is real. They're actually both real. They're both present. Who's to say which is more or less real? Who's to say which is the illusion? So I want to propose a more pragmatic and simpler way to think about this that might be more useful. And it comes out of Buddhist philosophy of mind. There's no religion in it. It's just

a way of thinking about the way the mind interprets patterns or data. The Buddhists talk about the expert mind and beginner mind.

Guess what? Most of us are really good at expert mind because the core function of an expert mind is pattern matching. In an earlier interview we talked a lot about this. It's actually how most of us got to where we are in our careers. We're really, really good at walking into a situation where we don't know everything and just immediately matching the data to some kind of pattern in our minds. The really fantastic management consultants, of course, are the best at this. They're pattern matchers. But what about the value of the beginner's mind? Think about the 11-month baby and the last time you saw an 11-month-old baby. What does it do? It doesn't have the patterns already established in its mind to tell it what to look at and what not to look at. It just reaches out to touch things in the environment. Its pattern matching system is remarkably underdeveloped. And this can be a real strength at times when dealing with things that look like pragmatic paradoxes or optical illusions. It's really good, I think, to adopt the 11-month-old baby attitude every now and again. Maybe it's easier if you just think of it as a beginner's mind. Try it for the next couple days. Just adopt it twice a day and see what you find out.

10.18 Premortum Analysis

Please view the following video linked below. In the video, Daniel Kahneman discusses his favorite debiasing technique.

This element addresses the following learning objective of this course:

- LO6: Navigate organizational, personal, legal, and ethical constraints to facilitate better decision making and improve communication.

[Nobel Laureate Daniel Kahneman - Premortem to Eliminate Thinking Biases](#)