PRINCIPLES OF BEHAVIORAL ECONOMICS

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Week 13

Lecture 13

I again welcome you back to the course on principles of behavioral economics. This is lecture 13 or module 13, where we are going to talk about bounded rationality and heuristics. Basically, from this module onwards, we will be specifically talking about how the neoclassical model and/or its standard description, the standard model, is observed to be violated historically. So, bounded rationality is one such concept that questions the neoclassical tradition.

Similarly, we will talk about different heuristics which are offered as an explanation for why people deviate from what is claimed by the neoclassical tradition. And after that, we will get into theoretical model building, of how these anomalies are basically modeled in different contexts, have been given different names, and things like that. So, beginning with bounded rationality, it was introduced by Herbert A. Simon. He introduced the concept of bounded rationality in his book Models of Man.

It challenges the assumption of perfect rationality in traditional economic models. Rationality is limited by cognitive capacity, available information, and time constraints. Bounded rationality is the idea that rationality is limited when individuals make decisions, and under these limitations, rational individuals will select a decision that is satisfactory rather than optimal. So, so far as you understand, it was assumed that—or neoclassicals assume that—we always go for an optimization problem.

come up with an optimal solution. We set a maximization problem. We obtain the maximum possible outcome, which is the best possible outcome for us. Alternatively, we call it optimal. But Herbert Simon came up with this concept that our rationality is bounded by our ability.

So, now we are going to expand on this concept. So, the limitations which basically stop us from making rational decisions include the difficulty with decision making, the

cognitive capability of the mind and the time available to make the decision. Decision makers in this view act as satisficers, seeking a satisfactory solution with everything that they have at the moment rather than an optimal solution. So, we would be satisfied, we seek to be satisfied and we do not seek to optimize.

That is the basic difference that Herbert Simon talked about. Therefore, humans do not undertake a full cost-benefit analysis to determine the optimal decision. Rather, choose an option that fulfills their adequacy criteria. Some models of human behavior in the social sciences assume that humans can be reasonably approximated or described as rational entities, as in rational choice theory or Downs' political agency model.

However, bounded rationality can be said to address the discrepancy between the assumed perfect rationality of human behavior, which is utilized by other economic theories, and the reality of human cognition. In short, bounded rationality revises notions of perfect rationality to account for the fact that perfectly rational decisions are often not feasible in practice. This is due to the intractability of natural decision problems and the finite computational resources available for making them. The concept of bounded rationality continues to influence and be debated in different disciplines, including political science, economics, psychology, law, philosophy, and cognitive science.

We will discuss an important concept in bounded rationality: satisficing. Satisficing is the strategy of considering the options available to you for choice until you find one that meets or exceeds a predefined threshold—your aspiration level—for a minimally acceptable outcome. As I was saying, we basically want to be satisfied, and we do not always seek an optimal solution, or perhaps we perceive the satisfactory solution as the optimal one.

From this, the concept of satisficing emerges. However, each individual may be satisfied in different ways, and this depends entirely on aspirations. For example, if I go on vacation, I might be satisfied with one type of hotel, while others might prefer a different type. If my aspirations are modest—just a decent room with AC, cleanliness—I will be happy.

So that is my aspiration. I'll be satisfied to find such a room, but then people Maybe those who are financially better off than me would be looking for resorts with great views of certain places. So if you are going to the hills, you would look for a hill-view room. You might need a suite or a heritage stay. Accordingly, these are basically your aspirations—what you expect from that trip or in terms of your accommodation for a particular trip.

Accordingly, that determines your satisfaction or level of satisfaction—whether you would be satisfied or not. Simon originally viewed the study of bounded rationality as concerning the behavior of human beings who satisfice because they lack the wits to maximize. So Simon's satisficing strategy, if we look at it in a nutshell, is first of all decision-making under uncertainty. Then what we primarily try to think is how to avoid catastrophic consequences. So we should be careful.

We should not make a decision that leads to a catastrophe. It is not always about running into an accident or something. We must not have an extremely unpleasant experience. Then that leads to forming or using some heuristics. We will talk about heuristics beginning with this module itself.

And then finally, that would lead to a solution which is going to satisfy us, and that would be sufficient for us. So, bounded rationality says that as our effort increases, the value associated with that effort also increases. So, we have an upward-sloping line like this.

Now, this could be an optimal solution, which is a perfect one, which is the best one, but that seems to be an impossibility. So, depending on our aspiration, we would be happy or satisfied with something which is good enough. So, if my aspiration level is up to this much, then I will be happy with this much effort and this much outcome. Similarly, if I have higher aspirations, I will go up to this.

Those people who look for actual perfection are extremely ambitious in life. They can actually reach this extreme point. Unless and until I reach that particular goal, I'll never be satisfied. I want to be a millionaire. I want to be a billionaire. I want to be extremely successful. The entire country should know my name. So, if that is your aspiration level, you will not be satisfied until you reach this position. So, that's all about decision-making: where you are going to stop.

There are a range of applications of satisficing models to sequential choice problems, aggregation problems, and high-dimensional optimization problems. These are increasingly common in machine learning. Given a specification of what will count as a good enough outcome, satisficing replaces the optimization objective from expected utility theory of selecting an undominated outcome with the objective of picking an option that meets your aspirations.

So, the simple thing is that the optimization objective is basically selecting an undominated outcome, the best possible outcome. Of course, it will not be dominated by anything. You replace it with the objective of picking an option that meets your aspirations—you are satisfied. The model has since been applied to businesses, mate selection, and other practical sequential choice problems like selecting a parking spot.

Many of our self-inflicted problems arise and/or persist because the capacity of the human brain often falls well short of what is needed to solve problems in the best way possible or to address one kind of problem without creating another. This is why, for Nobel laureate Herbert Simon, the focus of behavioral economics needed to be on the concept of bounded rationality. Three cognitive limitations stand out as especially problematic for decision-makers in the real world, though they do not always result in poor choices, even in challenging choice environments. They are, first, the brain's information processing speed.

Second, the capacity of the working memory. And the third one is the imaginative capacity of individuals. So first of all, we talk about the brain's information processing speed. The brain's information processing speed is a major constraint on filtering out irrelevant stimuli and accounting for pertinent information. So what is the information that is relevant for my decision-making?

I need to filter it out. At times, if I do not have sufficient time, then possibly my mind or my brain will not be able to process the information at high speed. For example, we can have trouble keeping up with taking notes on a lecture, or we get into difficulties when trying to sight-read a complex piece of music at the intended tempo. So, when you talk about the speed of information processing or brain speed for information processing,

then you understand that where we need to speed up, it is possible that I will not be able to speed up as much as required. As a result of which, if it is leading to a particular decision-making situation, then my decision might not be the optimal one. If we must make complex choices in a hurry, we may not have enough time to compute all their potential implications, even if we are making decisions in an environment that is free of distracting stimuli.

The things that we end up failing to consider may then confound our attempts to meet particular ends. If we are cognitively exhausted, the risk of information processing errors increases further. Now, talking about the second aspect: the capacity of working memory. Although our long-term memory capacities may be prodigious in some areas of our lives,

the working memory capacity of the human brain is severely limited. You might understand that we happen to recall, at times, many smaller or minute details of our childhood or some previous incidents or childhood memories.

We happen to remember such things. From that perspective, long-term memory capacities could be prodigious. But when it comes to working memory capacities, we have pretty much huge limitations. George Miller famously argued that people can only keep around 7 plus or minus 2 things in mind when working on a problem. This phenomenon is sometimes referred to as Miller's Rule.

Consequently, we are prone to, first of all, make errors when doing complex mental calculations, specifically involving various dimensions exceeding 7 plus or minus 2. Forget some of our options if the range of choices is large. Fail to keep in mind features of the options that we do manage to remember and forget things we intended to refer to when considering what to do. Then, coming to the third aspect: imaginative capacity. Humans have limited capacities to imagine what is possible.

This issue tends not to be given the attention that it deserves within the literature on bounded rationality but is a key theme in the writings of George Shackle. Of course, having a limited imagination often has the benefit of ensuring that we do not worry about things that should not trouble us. For example, as Shackle noted, we do not typically concern ourselves with whether there will be a tiger in our bathroom or not. Because, of course, we know that we cannot have—or we won't have—a tiger in our bathroom. So, things which are completely irrelevant or impossible do not bother us, but of course, imagination is.

A kid might have imagination, or their imaginative capacities are extremely high, but of course, they are not put to any use. In the sense that they do not imagine as part of their decision-making process. As a result, they have very wild and vivid imaginations. But when grown-ups make decisions, then, of course, they do not have this absolutely impossible imagination impacting their decision-making, which is, in some way, a good thing. However, as a result of failures of our imagination, we may fail to consider

possibilities that turn out to be relevant to the performance of options we consider, or we base our expectations on assumptions that lead us to be overly optimistic or unduly pessimistic. So, we should be able to anticipate possible situations, outcomes, or distractions when trying to make a decision. Hence, when events surprise us, it is often because we did not even dream that they might be possible, rather than viewing them as

unlikely. There is no guarantee that, even in the long run, we will be able to operate with ideal levels of wariness on every occasion.

So that is because of our limited imaginative capacity. Imagination has a lot to do with innovation. Bounded though it is, the human imagination clearly has enough creative power to make innovation possible. And because humans crave novelty, innovators focus on dreaming up new products rather than merely competing by finding ways of cutting the costs of making existing products. We are having better, more improved products and, at the same time, many new products.

This is problematic for both buyers and sellers from some perspectives. Schumpeter said, In 1943, he emphasized that the fruits of innovation tend to be short-lived, as the success of a firm's innovations puts its rivals under pressure to engage in retaliatory innovation. And this is what he calls creative destruction, in the sense that the firms which actually— or this results in creative destruction in the sense that the firms which are not sufficiently competitive, which are not sufficiently creative,

they will be destroyed over a period of time because competing firms come up with new and new innovations, they will capture more and more market share. So if you do not join the race, then of course you are going to perish. This is what Schumpeter's concept of creative destruction is, where innovation and imagination play an important role. This often results in the market life cycles of innovative products being much shorter than the operating lives of the products themselves.

So the first point of imagination and innovation that we just talked about impacts the sellers. Now we can also look at how it impacts the buyers. By the time the buyers return to the market to obtain replacements, the competitive landscape may have changed drastically. So, of course, there are some products whose parts are no longer produced by the companies. The companies still exist, but they have moved on to much more advanced products.

And if I am holding on to or using a pretty old product, then maybe its parts are not available, its services are not available, or possible from the company. So this is what is meant here. Even where buyers are more frequently in the market for particular products, constantly changing menus of incrementally upgraded options exacerbate the significance of their cognitive limitations. By making it harder for them to choose via experimentation or by watching the experiences of others.

So too many new products flooding the market also makes decision-making for the consumers or the buyers extremely difficult because comparison becomes very difficult. The market is changing pretty fast. Now we talk about what role heuristics play in circumventing these kinds of problems. So there are two ways by which we can try to circumvent our cognitive limitations so that we do not end up with avoidable problems. One is to use rules or heuristics to reduce the cognitive demands of making decisions.

Some of the heuristics that we use in attempting to solve problems are hardwired products of human evolution. This means that they once enhanced the competitive fitness of humans in general, and it also implies that now they are very much part of our system. So it has become almost an instinctive thing. Of course, when we use heuristics, it is not guided by any external stimuli. Heuristics are rules of thumb, which are basically recognized by our system, our mind, our brain.

And these are used in decision-making processes. The outcome could be good, bad, biased, or unbiased. That's a different thing altogether. So heuristics ideally aid our decision-making process. We'll take an example of search heuristics.

Search heuristics are basically the process of acquiring information such that the benefits exceed the costs involved in the process. So how I am searching for a particular product, maybe, or in the process of decision-making, I am looking or searching for the best possible solution. Suppose an individual, we call him or her A, wants to buy breakfast cereal. Her utility from breakfast cereal depends on money left, that is X. Taste quality, TQ, and health quality, we call it, say, HQ.

And the utility function looks like this. So, this is the utility function. See, utility depends on the money that she will be left with, the taste of the cereal, and the health aspect of the cereal. And this is how we write the utility function. This is the functional form.

It is a linear functional form.

$$u(x,TQ, HQ) = 20 \sqrt{x} + 2TQ + HQ$$

We also assume that she has $100 to begin with. Now I have reproduced the utility function here.

Product/ choice	Price	TQ	HQ	Wealth	Utility
No cereal	0	0	0	$100	200
Budget	$1	1	1	$99	202
Nutty	$3	2	2	$97	203
Honey	$4	3	2	$96	204
Superior	$6	3	3	$94	203

Now this table basically shows there are four different breakfast options. We call them budgets.

This has the lowest price, say $1. Then there is one flavor, which is nutty, priced at $3. Another flavor is honey, priced at $4. And then there is superior, which is priced at $6. If I do not purchase, or if that individual A does not purchase any cereal, then of course there is no price to be paid. So this is one option still there.

Now, the health quality or health aspect of an individual breakfast cereal would be reflected on the package. It would talk about the nutritional information. Taste is something that is not mentioned anywhere, as it is again a subjective dimension. So, one needs to actually taste it in order to understand how it tastes. Now, we have certain numbers associated with the taste quality and health quality, TQ and HQ.

Maybe that is based on the information obtained from individuals who have previously used these breakfast cereals. So, Budget has some taste. Then, Nutty, Honey, and Superior taste better. Superior actually has the highest health quality. Nutty and Honey have similar health aspects.

Now, this is the amount of money that would be left once one particular breakfast cereal is purchased. So, we can call it X. If that individual is not purchasing any cereal, then he would be left with, of course, a value of $100. And if I plug in this value into this expression—so nothing is being purchased, HQ0, TQ0, 20 raised to the power 100. That gives us a utility of 200. In a similar fashion, when the individual purchases Budget, then she pays $1.

She is left with $99. And then I have 20 multiplied by the square root of 99 plus 2 times taste quality 1. So 2 times 1 plus health quality 1. Similarly, I will have these numbers: 200, 202, 203, 204, and finally 203 again for superior. These are the total utilities that the individual would get by consuming each one of these breakfast cereals.

Now, how is she going to decide? We are going to talk about five heuristics. The first one is: try everything. The second one is satisficing. The third one is directed cognition.

The fourth one is elimination by aspects. And the fifth one is when a person decides how much time to spend on search and then searches for that long. So there is not much to talk about this heuristic. It so happens that I enter a shop, I want to buy something, but I'm in a hurry. So I'll spend much less time looking for or searching for things.

So whatever is being shown to me, I'll pick up. Something that catches me or that I find the most interesting, most useful, or most attractive, depending on what it is I'm trying to buy. And then I pay, I leave the shop. Those individuals—suppose I want to spend the entire evening shopping. So, leisurely, I get into one shop and spend a lot of time there.

Of course, I pick the one I like the most. I may pick several, or I may not pick any. So, this is, of course, one idea where you just devote a certain amount of time accordingly. You search for things and take a call. But other than that,

When we talk about individual heuristics, first of all, we begin with 'try everything,' as the name suggests. This is the most obvious search heuristic, and that is 'try everything.' So that individual A could try a different cereal every week until she has tried them all, and then subsequently buy the one she liked the most. However, the process will be costly. Why is this so? Because suppose that in the first week she tries honey and can tell that she likes it a lot.

She would have been better off just sticking with honey because if she tried nutty in the next week, then she would not get as much utility as she would get from honey. So there is a reduction in utility. Some time is also involved. Some money is also spent.

If I go back to the utility table, then you can see that Nutty produces a utility level of 203, which is lower than Honey. So since Honey gives the highest utility, if you try Honey in the beginning, then trying the rest of the things, is actually a waste of time because they are anyway going to add lower utility to the individual. That's why we call it an expensive heuristic. In this case, search proves costly in terms of foregone utility by consuming Honey every week—that is, for the rest of the three weeks when she would be trying other varieties. If she had consumed Honey, then every week she would have gotten the maximum possible utility.

But by consuming other varieties, she is actually getting lower and lower utility. So that is why there is this concept of foregone utility. Search can also be costly in terms of time

and money. So, for example, when she tries Superior, she pays a price which is higher than that of Honey. But nevertheless, she does not enjoy it as much as she enjoyed Honey, so as a result, there is also wastage in terms of money.

And of course, she spends time trying different varieties which are actually not as good as honey. Next talking about satisficing the second search heuristic the basic idea behind satisficing is that a person sets some aspiration level for what they are looking for and continues to search until they find something above the aspiration level. So exactly how it has been explained by Herbert Simon's bounded rationality. For example, A may decide she wants something that tastes good and is reasonably healthy.

This determines her aspiration level and she will keep on trying cereals until she tries honey or superior. Once she tries any one of them then she would not need to try anymore. So, satisficing relaxes the objective from finding the optimal choice to merely finding a choice that is good enough that we have already talked about. So, in that case that actually narrows down her choices. She can always begin with honey or superior or nutty or honey.

This means a person may not end up with the best but they will end up with something relatively good while avoiding the cost of excessive search. For example, if I am too thrifty, I just want to save more money, so I will be going for budget. By consuming budget, I might have higher utility or that is my aspiration level that I am able to save the maximum amount of money.

So that is going to satisfy me. That would be my search heuristic, or that would be the outcome of my search heuristic. How close satisficing comes to the optimum will depend on the aspiration level. The third one is directed cognition. The idea behind directed cognition is that a person treats each chance to gather information as if it is the last chance.

Before they have to make a choice. To illustrate, suppose she knows only the characteristics of nutty—how it tastes and how healthy it is. Using directed cognition, she should ask herself, 'Should I try one alternative cereal, and if so, which one?' So, again, this narrows down the alternative options or available options to her. This is a much simpler question compared to

forward planning, where there are many more permutations that need to be considered. So forward planning would be like, 'What after nutty? Then what after that? Which one

should I go for?' So basically, again, that refers to other kinds of heuristics where you have many more options to explore. When it comes to narrowing down, then this is one possibility. You are directing your cognition to one particular variety or variant and after that, just explore around it.

The fourth one is elimination by aspects. The basic idea of elimination by aspects is to consider the aspects of possible choices one by one and sequentially eliminate choices that fall below some aspiration level. So again, the aspiration level is there, but this assumes that we have information about all possible variants and accordingly, I am going for elimination. For example, if A's aspirations are to buy a cereal with medium taste and health quality, for under $5, then on the price aspect, she would eliminate Superior.

So, Superior is eliminated. Now, you are left with only three variants. And on the quality aspect, she might eliminate Budget. Then she would be left with only two variants. So this would leave a choice between Honey and Nutty only.

Elimination by aspects compares across aspects such as price rather than across choices such as Honey or Nutty. Conceptually, it is simpler to compare across aspects because there is likely to be a simple ordering from best to worst. The problem is that comparing across aspects presupposes that the person has information about all the possible choices, which might not always be the case. If we assume that there is perfect information, then again we go back to the neoclassical model itself. That people have all the information, then of course, they would not probably need any heuristic.

Rather, they would be making the optimal choice, the best possible situation. So, elimination by aspect, to some extent, resembles the neoclassical approach. So, with this, I conclude this lecture on bounded rationality and some of the heuristics. There are more heuristics we will talk about in future modules. Next, I will talk about biases.

Thank you.