

5-2020

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Technical Report: UTEP-CS-20-43

Recommended Citation

Bokati, Laxman; Kosheleva, Olga; Kreinovich, Vladik; and Thach, Nguyen Ngoc, "Economics of Reciprocity and Temptation" (2020). *Departmental Technical Reports (CS)*. 1442.

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Economics of Reciprocity and Temptation

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Abstract

Behavioral economics has shown that in many situations, people's behavior differs from what is predicted by simple traditional utility-maximization economic models. It is therefore desirable to be able to accurately describe people's actual behavior. In some cases, the difference from the traditional models is caused by bounded rationality – our limited ability to process information and to come up with a truly optimal solutions. In such cases, predicting people's behavior is difficult. In other cases, however, people actually optimize – but the actual expression for utility is more complicated than in the traditional models. In such case, it is, in principle, possible to predict people's behavior. In this paper, we show that two phenomena – reciprocity and temptation – can be explained by optimizing a complex utility expression. We hope that this explanation will eventually lead to accurate prediction of these phenomena.

1 Formulation of the Problem

Behavioral economics: a brief reminder. Traditional economic models assumed that people thoroughly analyze all their options and make optimal decisions based on this analysis.

In many decision-making situations, this assumption works reasonably well and leads to a reasonably accurate description of an overall economic process. However, many research results performed in the last decades – some of them of Nobel Prize quality – have shown that in many practical situations, the actual people's behavior differs from the assumed ideal one. The analysis of such behavior and its economic consequences is known as *behavioral economics*.

Challenges for behavioral economics. Behavioral economics provides con-

vincing and impressive examples of people’s non-optimal behavior. However, in many cases, it does not provide us with quantitative models that would predict actual people’s behavior. Coming up with such models is an important challenge for behavioral economics.

One way to come with such predictions is to better understand why people’s behavior differs from the predictions of traditional economic models – so that, hopefully, this understanding will lead us to the desired predictions.

Why people’s behavior differs from the traditional economic predictions: two main reasons. There are two main reasons why people’s behavior differs from the traditional economic models.

The first reason is that when making decisions, people often have limited ability (and limited time) to make a decision. As a result, they sometimes make a sub-optimal decision. In such situations, it is, in general, not easy to come up with the adequate model of people’s behavior – this requires a deep knowledge of how exactly we process limited information in our brains.

However, there is another reason why people’s behavior is often different from what the traditional economic models would prescribe. Namely, many traditional economic models – models that assume that each person wants to maximize his/her gain (usually formalized as utility) – provide an oversimplified understanding of how people gauge the gains from different possible actions. In such situations, in principle, we can come up with quantitative models of human behavior – for this, we need to provide more adequate, more accurate models of human utility.

Such situations are the “low-hanging fruits” of this research areas, topics in which there is the biggest hope of reaching quantitative descriptions of human behavior.

What we do in this paper. In this paper, we provide two examples of such phenomena, examples that correspond to (seemingly unrelated) phenomena of reciprocity and temptation. It turns out that while, from the economic viewpoint, these are two different behaviors, they can be explained by using similar ideas and similar techniques.

2 How to Make Traditional Models More Adequate: Empathy and Discounting

Utility in the traditional economic models. In the traditional economic models, it is usually assumed that a decision maker maximizes his/her gain (numerically expressed as utility u), and this utility value describe the effect of this decision on this person at this particular moment of time; see, e.g., [7, 15, 23, 24, 28].

Need to go beyond traditional models. In these models, person’s decisions are not affected by gains (utilities) of others and/or by gains of the same person at future moments of time. To some extent this is true, but one can easily find

examples where gains of others (and/or future gains of the same person) do affect our behavior.

Maybe a proverbial greedy capitalist would gladly earn an extra million by making his workers work more and thus, get less utility, but in general, hardly anyone would prefer, e.g., \$101 to \$100 if this increase is accompanied by someone's severe suffering. Some people spend all their money like there is no tomorrow and retire in poverty, but most people do limit somewhat their current expenses to save for retirement. It is all a matter of degree. Some people are not empathetic enough, some do not save enough – but to some degree, practically everyone is empathetic and practically everyone saves (at least something).

How to describe dependence on other's utilities. Let $u_i^{(0)}$ be approximate utilities that come only from this person's consumption. How can we describe the actual utilities u_i that take into account other people's feelings – i.e., in precise terms, other people's utilities?

A natural way is to add, to $u_i^{(0)}$, terms proportional to other people's utilities, i.e., to consider expressions of the type

$$u_i = u_i^{(0)} + \sum_{j \neq i} \alpha_{ij} \cdot u_j, \quad (1)$$

where each coefficient α_{ij} describes how the utility of the i -th person depends on the utility of the j -th person; see, e.g., [1, 2, 3, 4, 9, 11, 24, 29, 30, 35].

This phenomenon is known by a polite term *empathy*, since for positive values α_{ij} , this formula describes how people feel better if others around them are happier. However, from the purely mathematical viewpoint, it is also possible to have negative values α_{ij} , when someone's happiness makes the other person unhappy. This is not just a mathematical example, such things like jealousy and hatred are, unfortunately, quite real :-)

How to describe dependence on utility in different moments of time. In the traditional economic models, we assume that a person's utility at moment t is determined only by his/her consumption at this moment of time. In reality, in addition to this approximate utility u_t , the person also takes into account future utilities u_{t+1} , u_{t+2} , ..., and past utilities u_{t-1} , u_{t-2} , etc., with appropriate coefficients:

$$u = u_t + \sum_{j>0} q_j \cdot u_{t+j} + \sum_{j<0} q_j \cdot u_{t+j}. \quad (2)$$

This phenomenon is known as *discounting*, since a person usually considers future experiences as less valuable than the present ones: e.g., people will pay less than a dollar for a chance to get a dollar a year from now; see, e.g., [6, 8, 12, 13, 14, 18, 19, 27, 36].

What we will do now. Let us show that these two phenomena explain people's behavior corresponding to reciprocity and temptation.

3 Reciprocity: What It Is and How It Can Be Explained

What is reciprocity. Usually, people have reasonably fixed attitude to others: they feel empathy towards members of their family, members of their tribe, usually citizens of their country – and may be consistently negative towards their country’s competitors. However, in addition to these consistent feelings, they also have widely fluctuating attitudes towards people with whom they work – or at least with whom they are teams up in a experiment set up by a behavioral economics researcher.

It turns out that while it is difficult to predict how these attitudes will evolve – even in what direction they will evolve, positive or negative – there is a general phenomenon that people are nice to those who treat them nicely and negative to those who treat them badly. In terms of the coefficients α_{ij} it means that:

- if α_{ji} is positive, then we expect α_{ij} to be positive too, and
- if α_{ji} is negative, then we expect α_{ij} to be negative too;

see, e.g., [26, 31].

This *reciprocity* phenomenon is intuitively clear – this is, after all, a natural human behavior – but how can we explain it in economic terms?

Let us formulate the problem in precise terms. To explain the reciprocity phenomenon, let us consider the simplest case of formula (1), when we have only two people. In this case, the formula (1) for these two people takes the following form:

$$u_1 = u_1^{(0)} + \alpha_{12} \cdot u_2; \tag{3}$$

$$u_2 = u_2^{(0)} + \alpha_{21} \cdot u_1. \tag{4}$$

Since each person tries to maximize his/her utility, a natural question is as follows:

- suppose that Person 1 knows the attitude α_{21} of Person 2 towards him/her;
- what value α_{12} describing his/her attitude should Person 1 select to maximize his/her utility u_1 ?

Analysis of the problem. If we replace, in the right-hand side of the equality (3), the value u_2 with the right-hand side of the expression (4), we get

$$u_1 = u_1^{(0)} + \alpha_{12} \cdot u_2^{(0)} + \alpha_{12} \cdot \alpha_{21} \cdot u_1.$$

If we move all the terms containing u_1 into the left-hand side, we get

$$u_1 \cdot (1 - \alpha_{12} \cdot \alpha_{21}) = u_1^{(0)} + \alpha_{12} \cdot u_2^{(0)},$$

hence

$$u_1 = \frac{u_1^{(0)} + \alpha_{12} \cdot u_2^{(0)}}{1 - \alpha_{12} \cdot \alpha_{21}}. \quad (5)$$

This expression can take infinite value – i.e., as large a value as possible – if we take the value

$$\alpha_{12} = \frac{1}{\alpha_{21}}, \quad (6)$$

for which the denominator is 0. We can make it positive – and as large as possible – if we take α_{12} close to the inverse $1/\alpha_{21}$, so that the difference $1 - \alpha_{12} \cdot \alpha_{21}$ will not be exactly 0, but be close to 0, with the same sign as the expression $u_1^{(0)} + \alpha_{12} \cdot u_2^{(0)}$.

This explains reciprocity. Indeed, according to the formula (6):

- if α_{21} is positive, then the selected value α_{12} is also positive, and
- if α_{21} is negative, then the selected value α_{12} is also negative.

4 Temptation: What It Is and How It Can Be Explained

What is temptation. A popular book [34] by a Nobelist Richard H. Thaler starts the chapter on temptation (Chapter 2) with a simple example: a group of friends are given a big bowl of nuts before dinner. As they eat more and more nuts, they realize that if they continue, they will have no appetite for the incoming tasty dinner, so they decided to put away the bowl.

All this sounds reasonable, until we start analyzing it from the economic viewpoint. From this viewpoint, the more options we have, the better, so how come the elimination of one of the options made everyone happier?

This is just one example; for other examples and for a general analysis of this phenomenon, see, e.g., [5, 8, 10, 16, 20, 25, 32, 33, 34].

What if we take discounting into account. Let us try to resolve this puzzle by taking discounting into account. Let us denote the overall amount of food that a person can eat in the evening by a (e.g., by a grams), the utility for eating one gram of nuts by n , the utility of eating one gram of dinner by d , the discounting coefficient from dinner to now by q_+ , and the amount of nuts that we eat now by x . The variable x can take any value from the interval $[0, a]$.

In terms of these notations, when we eat x grams of nuts and $a - x$ grams of actual dinner, then, taking into account discounting, the overall utility now is equal to

$$n \cdot x + q_+ \cdot d \cdot (a - x). \quad (7)$$

According to the usual decision making idea, we want to select the amount x for which this utility is the largest. But the expression (7) is linear in x , so its largest value on the interval $[0, a]$ is attained at one of the endpoints of this

interval, i.e., either for $x = 0$ or for $x = a$. In the first case, we do not eat any nuts at all, in the second case, we only eat nuts and do not eat any dinner. This may be mathematically reasonable, but this is *not* how people behave! How can we explain how people actually behave?

Taking into account that at different moments of time, people have different preferences. In the previous text, we assumed that the only way a person takes into account future events is by discounting. This would make sense if the same person at different moment of time has the same preferences. In reality, people’s preferences change. To some extent, the same person at different moments of time is a kind of a different person. So, a proper way to take that into account is to realize that when a person makes decision, he or she needs to find a compromise between his/her today’s interests and his/her interests at other moments of time.

This situation is similar to situation of joint decisions making, when several people with somewhat different interests try to come up with a group decision – the only difference is that different people can decide not to cooperate at all, while here, “agents” (i.e., the same person at different moments of time) are “joined at the hip” – decisions by one of them affect another one. Thus, to properly describe decision making, we need to view the problem as a problem of group decision making – group decision making by agents representing the same person at different moments of time.

According to decision theory, a group decision of several cooperating agents should be maximizing the product of their utilities. This is known as *Nash’s bargaining solution*; see, e.g., [23, 21, 22]. So, in our case, a person making a decision should be maximizing the product of the utilities at different moments of time.

Let us show, on the above example, that this indeed helps us avoid the above un-realistic prediction that we should have $x = 0$ or $x = a$.

How this idea help. Let us consider the simplest case of two moments of time: the original moment of time when we are eating (or not eating) nuts, and the future moment of time when we will be eating dinner. In the original moment of time, the utility is described by the formula (7). Similarly, at the next moment of time, the utility is described by a formula $q_- \cdot n \cdot x + d \cdot (a - x)$, for an appropriate discounting coefficient q_- . Thus, the correct value x is the one that maximizes the product

$$(n \cdot x + q_+ \cdot d \cdot (a - x)) \cdot (q_- \cdot n \cdot x + d \cdot (a - x)).$$

This function is quadratic, and, in contrast to linear functions, the maximum of a quadratic function on an interval is not necessarily attained at one of the interval’s endpoints.

Let us illustrate it on a simplified example where computations are easy: $a = 1$, $n = 1$, $d = 2$, and $q_+ = q_- = 0.25$. In this case, we maximize the function

$$(x + 0.5 \cdot (1 - x)) \cdot (0.25 \cdot x + 2 \cdot (1 - x)) = (0.5 \cdot x + 0.5) \cdot (2 - 1.75 \cdot x).$$

Differentiating this expression with respect to x and equating the derivative to 0 leads to

$$0.5 \cdot (2 - 1.75 \cdot x) + (0.5 \cdot x + 0.5) \cdot (-1.75) = 0,$$

i.e., to $0.125 = 1.75 \cdot x$ and

$$x = \frac{0.125}{1.75} = \frac{1/8}{7/4} = \frac{1}{14} \approx 0.07.$$

The values a , n , etc., were kind of random, but the resulting proportion of nuts snack in the food – about 7% – is quite reasonable.

Comment. So why is everyone happy that the temptation was taken away? Because this allowed everyone not to violate their social contract – in this case, a social contract (as described by Nash’s bargaining solution) between a person now and the same person in the future.

Acknowledgments

This work was supported in part by the National Science Foundation grants 1623190 (A Model of Change for Preparing a New Generation for Professional Practice in Computer Science) and HRD-1242122 (Cyber-ShARE Center of Excellence).

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