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Prospect Theory

This March we celebrate the 36th anniversary of the publication of one of the seminal articles on Behavioral Science. In March of 1979, Daniel Kahneman (Nobel Prize of Economics in 2002), along with his colleague Amos Tversky, published in Econometrica their article "PROSPECT THEORY: AN ANALYSIS OF DECISION UNDER RISK". This would turn out to be the first step towards the creation of the economics branch with the biggest growth, dynamism and dissemination today, Behavioral Economics.

Kahneman and Tversky´s Prospect Theory, presents an alternative to traditional Expected Utility Theory, which dominated the analysis of decision making under risk until then. Like any theory that challenges the status-quo, it was not exempt from critics and disqualifications, nevertheless, the insights that Prospect Theory provided on the inconsistency in people's preferences and the fact that Prospect Theory allowed economists to explain the majority of the deviations from rationality that Expected Utility Theory couldn´t, made it a very useful tool for decision research. Today, taking contributions from psychology, sociology and more recently neuroscience, Behavioral Economics provides the knowledge that allows us to explain with much more precision the decision making process of people and accurately predict deviations from rational behavior in people's lives.

In this study we explain Prospect Theory, and show results of field experiments that we have conducted both publicly and in the classroom to complement and argue in favor of Prospect Theory.

Nothing is Absolute, Everything is Relative

Expected Utility Theory establishes that the utility of wealth is what ultimately dictates the level of happiness that people experience. In other words, the higher the utility the more happiness one has. However, an important feature of Expected Utility Theory is that it does not pretend to be a psychological model, but rather a logic representation of decision making based on axioms of rationality (like independence and transitivity). This makes it a viable mathematical model, although it's still unable to explain some "anomalies" in decision making. To exemplify, let's imagine the next case:

Today Emily and Karl woke up with $500,000 in their bank accounts.
Yesterday Karl had $100,000 and Emily had $900,000 in their accounts. Who is happier today?

It's clear that Karl is much happier than Emily with the $500,000 in his account. Karl would even be much happier than Emily if he had $200,000 instead of $500,000, and Emily still had $500,000. However, according to Expected Utility Theory, both should be equally happy with their $500,000 as they both experience the same utility that comes from having $500,000. But do you really think that both of them are equally happy?

The fact that Expected Utility Theory does not consider a reference point to measure utility, makes it unable to explain the happiness of Karl and the sadness of Emily. In this case both of them see the $500,000 from very different perspectives; Karl sees a gain of $400,000, while Emily sees a loss of $400,000 related to their reference point, which is their wealth yesterday.

This simple concept triggered a revolution in the study of decision making under risk, which eventually reached the whole of economics. And how would it not trigger it? We're talking about the publication of an article written by two psychologists in one of the main economic journals, questioning (in a rather successful way) one of the fundamental theories in economics. Fortunately, the reception of the article was good, and today Kahneman & Tversky (1979) is one of the more quoted references in economic research, which now uses Prospect Theory in a regular basis.

Prospect Theory

Prospect Theory is based in 3 main concepts:

- Relative evaluation vs a reference point
- Diminishing sensitivity
- Loss aversion

Relative evaluation vs a reference point

As we saw with the example of Karl and Emily's wealth, Prospect Theory was finally able to explain the loss and gain feeling that both experienced and that Expected Utility was unable to explain. When introducing a reference point, we cannot only quantify the money utility by itself, but also we can quantify the relative utility against other relative states of wealth. The reference point tends to be the status-quo, however, it can also be an expected point in the future like a bonus or a pay-rise. It's important, however, to mention that although the evaluation is usually weighed vs monetary reference points, it can also be made with non-monetary reference points, e.g., Karl (1.80m) is tall in Peru, but average in Norway.

Diminishing Sensitivity

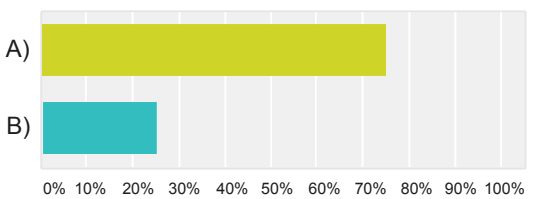
The concept of diminishing sensitivity is similar to the concept of marginal benefit, however, unlike this concept, diminishing sensitivity is purely a psychological reduction in the utility of money. In other words, the utility of the $100 that make the difference between $1,500 and $1,600 won't generate the same value that the $100 that make the difference between $200 and $300. Weird? We know, since those $100 are $100 here and in China, right?

Now we present the results of a survey applied between the months of November and December in Mexico, with which we looked to capture the concept of diminishing sensitivity. The surveys were applied online, and consisted of two questions related to buying a specific product and the possibility of saving some money if the subject decided to change stores in order to grab a better deal. Each subject had to answer both questions in a multiple-choice type of survey. The questions were as follows:

You are at an office supply store and you find a pretty pen for $250 pesos. You are about to buy it when you remember that the same pen is on sale for $180 pesos in another store 15 minutes away. What would you do?

A) You decide to go to the other store to buy the pen

B) You decide to buy the pen in the store you are already at



Facing the decision of whether to buy a pen or to take the trip to store B in order to save $70, 74.6% of the subjects decided to take the $70 discount in exchange of the 15 minutes trip to store B. This decision makes sense since we are talking of a deal that gives you a discount of 28%, and the cost of getting this discount is "only" a 15 minutes trip to the other store (very small amount of time for Mexico City's average commute),

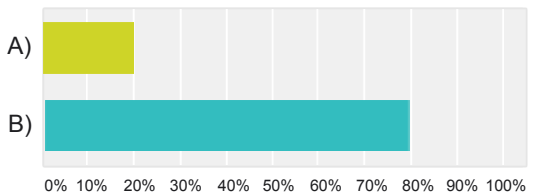
so people are willing to do it.

Now let's take a look at the second question.

You find a luxurious suit/dress perfect for your job and you decide to buy it for $4,550 pesos, but in that moment another client tells you that the same suit/dress is on sale for $4,480 in another store 15 minutes away. What would you do?

A) You decide to go to the other store to buy the suit/dress

B) You decide to buy the suit/dress in the store you are already at



In this case, facing the choice of buying a suit/dress, subjects are confronted by the same situation as in question 1. The cost of the suit/dress is $4,550, while in a store 15 minutes away the same suit/dress retails at $4,480. This time, 80% of the subjects decided to stay in the original store and buy it, as this time, the price reduction represents a discount of barely 1.5%. Clearly there is a change in people's preferences, as the majority decided to change stores for a 28% discount, but to stay in the store for a 1.5% discount, although both cases translated into a discount of $70. Does this really make sense?

There are two elements that stay constant in both questions and help demonstrate the existence of the concept of diminishing sensitivity: 1) the 15 minutes commute between stores that participants face in both cases; and 2) the money discount, which in both cases is $70. The fact that there's a preference reversal when facing an identical monetary difference ($70 in both cases) shows us that we don't really value consistently those $70. We attach certain value to them when they represent the difference between $250 and $180, and another completely different value when they represent the difference between $4,550 and $4,480. Just like the concept of the marginal benefit, diminishing sensitivity demonstrates that when the quantity we are evaluating diminishes in relation to its reference point, its perceived value decreases. Those $70 that we decided to save in the pen, are still $70 when we decided not to change stores to buy a suit/dress, but this time our reference point is bigger, which makes the utility we get from those $70 not seem enough to justify the 15 minutes trip we were willing to take when buying the pen.

Loss aversion

Loss aversion is probably the most important, more revealing and at the same time the simpler principle in Prospect Theory. This concept represents something we all know in a very simple way: losses are more painful than gains, which implies that

we prefer to avoid a loss than to pursue a gain.

By itself, this won't mean much to us, however, Loss Aversion has very important implications in our daily decisions, and it's something we are not usually conscious about.

We now present the results of an experiment made with students of the Universidad Iberoamericana in Mexico City, which clearly shows the presence of Loss Aversion in subject's choices. The experiment is quite simple and it shows consistent results with experiments done in other universities/labs.

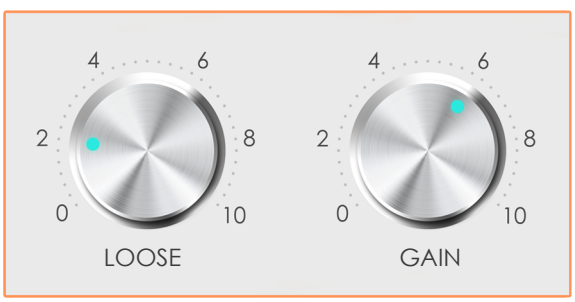
Each subject received a little paper sheet like the one below, and had the freedom to answer it in as much time as they considered necessary.

> We are going to bet in a coin toss. If the coin faces up blue, you gain X points in the final exam. If it faces up red, you loose 30 points in the final exam.
> How much should be X for you to be willing to bet with me?

The main objective of the experiment was to quantify how much did subjects' potential gain had to be in order to neutralize the possibility of incurring a loss, making the coin toss attractive to them.

If we value losses the same way we value gains, we would expect to see proposals that oscillate in the 30 points. But because we know of the existence of loss aversion, we hypothesized that the average answer would sit around 50-60 points.

The final results show that loss aversions clearly exists in subjects minds, since only one participant was willing to participate in the coin toss when facing a 30 points gain, while the average would do it for 58 points, almost double the potential loss. These results are consistent with other similar experiments made with money, in which the possibility of losing $100 generated answers that exceeded the $200 required to participate in the coin toss.



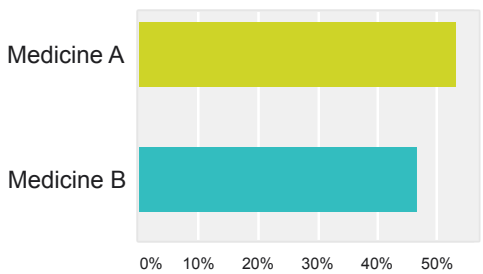
But, can we use the concept of Loss Aversion in our favor to facilitate people's choices? Fortunately we can, since we are not conscious of how much we dislike losses in relation to gains, it is possible for us to formulate situations in many different ways with the intention of making choices easier. So is the case of the next experiment.

With the intension of proving we could frame a situation in the context of gains and losses, in order to nudge people to change their choices, the next experiment was generated considering the methodology proposed by Kahneman & Tversky (1981).

You are the president of Cosiland, a beautiful island in the pacific with 600 residents. Cosiland faces a terrible epidemic of the mortal virus Alkosay, so you have to urgently choose to apply 1 of 2 experimental medicines to fight this virus. The future of the island rests on your shoulders, so you decide to apply:

- The medicine A that warranties to save 200 residents

- The medicine B that could save the whole island, but it has 2/3 of probabilities of not working and kill the whole population



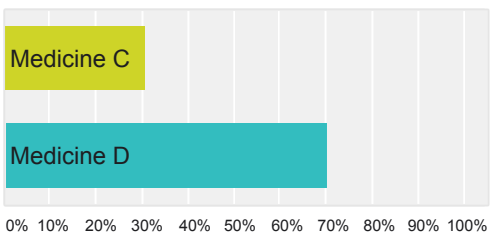
In this case, subjects were presented with the possibility of choosing between something safe, represented by medicine A, which gives the certainty of saving 200 residents, and an uncertain lottery represented by medicine B, which had a 66% chance of not working and killing all the residents of the island. As the graph shows, the answers were quite even, with 52% of the subjects leaning towards the certainty of saving 200 residents, and the remaining 48% choosing the uncertain lottery. Now, can this percentages change by reframing the question?

Fortunately or unfortunately (depending on everyone's own opinion), it is possible to modify the percentages of the answers just by reframing the options, as we can see in the next example.

You are the president of Cosiland, a beautiful island in the pacific with 600 residents.Cosiland faces a terrible epidemic of the mortal virus Alkosay, so you have to urgently choose to apply 1 of 2 experimental medicines to fight this virus. The future of the island rests on your shoulders, so you decide to apply:

- The medicine C that warranties to kill 400 residents

- The medicine D that has 1/3 of probabilities to save the whole population



The scenario is exactly the same, again subjects faced the chance of choosing between something safe, represented by medicine C, which would kill for sure 400 residents, and an uncertain bet represented by medicine D, which had a 33% chance of working and saving the whole island.

Surprisingly, in this scenario the answers changed with regard to the first one, with the uncertain option, represented by medicine D being the most popular choice with 70%, over the certainty of medicine C.

It's surprising that the preferences change so abruptly from one scenario to another, since in both cases the scenario is technically the same, as the medicines provide the same results in both cases.
What happens is that we have framed the effects of each medicine in a different way. Medicine A (certainty) saves with certainty, 400 residents (this means 200 of them die), while medicine C (certainty) ensures the death of 200 residents (which means it saves 400). In a different way, medicine B had 66% chances of not working killing the whole island (33% chances of working), while medicine D had 33% chances of working and saving the whole island (66% probability of not working).

There are two effects working in subject's preference reversals in this experiment. In the first place, the fact that in the second scenario the medicine that provides certainty is presented as the one that ENSURES the death of 400 residents and not as the one that ENSURES to save the life of 200 residents activates loss aversion in our brains. This unleashes the second effect, which is the appearance of a risk-seeking behavior, which generates a clear movement from a 50-50 in the first scenario to a 30-70 in the second.

One of the most important features of Loss Aversion is the fact that as the possibility of facing losses increases, we tend to be willing to accept more risks than we would normally do when facing gains. This reflects in a perfect way the clear selection of medicine D over medicine B, despite the fact that both are basically the same.

As we could see, Prospect Theory was the first theory to successfully combine traditional concepts of utility theory with cognitive factors, like loss aversion and risks, without losing its economic essence.
Thanks to this theory decision research and behavioral economics were able to position themselves as fundamental tools in the design and application of public policies.

Despite the clear success of Prospect Theory and the recent growth in the behavioral economics and decision research, new theories have been developed from the weaknesses of the original Prospect Theory to allow for quantification of aspects like regret and expectations, which we'll review in another study.

References

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Tversky, A., & Kahneman, D. (1981). The Framing of Decisions and the Psychology of Choice. *Science, New Series, Vol. 211, No. 4481,* 453-458

About NUDØ

We are a group of consultants based in Mexico City specialized in designing behavioral nudges. We are always looking to generate innovative ideas and solutions with a solid scientific and theoretical background, complementing this with empirical experimentation.

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