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ERGONOMICS OF HUMAN CHOICE

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Abstract:

More than 100 years ago, Herbert A. Simon wrote the book "The sciences of the artificial" (1916) where he presented Economics as an artificial science. Even though back then the mainstream economics promoted the idea of <homo economicus>, Simon's perspective of man was as one of an artificial system, characterized by a bounded rationality whose behavior depends on his inner and outer environment. Later, in the 70's Daniel Kahneman and Amos Tversky investigated more on the limitation of human rationality and built, based on empirical studies, the maps of bounded rationality. Later, Richard H. Thaler introduced the concept of nudge, as a way to improve people's choices by using the knowledge about their limited rationality and using it to direct their behavior in the direction in which they would have behaved if they were rational.

This article treats human behavior through the lens of ergonomics, a scientific discipline concerned with the understanding of interactions among humans and other elements of a system, and the profession that applies theory, principles, data and methods to design in order to optimize human well-being and overall system performance. We adopt the perspective of the man as an interface between his inner and outer environment and describe how behavioral economics developed a different perspective about human choice in contrast with the one promoted by standard economics.

Keywords: Human choice, Human behavior, Behavioral economics, Bounded rationality, Ergonomics

1. Herbert A. Simon's view on human behavior

One of the first voices raised against the standard economic model was the one of Herbert A. Simon. He argued that rarely in real life man can be found in an equilibrium state just as he is described in neoclassical economic theories, but he is more likely to be found as part of a dynamic environment. In this case, if economic theory was to predict his behavior in a correct manner, information about his purpose were not enough and details about their <internal structure> and <adaptive mechanism> (Simon, 1959) were needed.

In Simon's view decision theory was an important area of microeconomics. In contrast with standard economics, he defines the human decision making process as being <artificial>, the term being used to underline the adaptive way a person behaves in order to accomplish certain goals. His behavior is determined by his inner and outer environment and when he fails to adapt his behavior to the latter, he reveals the limits of his rationality. These limitations can correspond either to the individual, being related mainly to its lack of

exhaustive information or to its limited computational abilities (Simon, 1955) or to the environment in which the decision is made. The latter is subject to simplifications, each man having his own representation of the environment based on his perception of the real world and his own purposes and goals. (Simon, 1956) The presence of these limitations demonstrates that the concept of <global rationality> promoted by standard economics is a meaningless one. Instead of it, Simon proposed the concept of <bounded rationality>, concept that incorporates both <substantive> and <procedural rationality>. (Simon, 2000) Based on bounded rationality, Simon describes a behavioral model of choice in which man is seen as an information-processing being. (table no.1) The first step in this new choice model is problem representations when people organize the information so as to use the minimum effort to solve it. In the next stage, they <design> possible solutions by exploring the space of the problem, the search for a solution being guided by heuristics. (Simon, 1916) Finally, the choice process ends with comparing the alternatives with an <aspiration level>, this component being the one that gives the behavioral model of choice a dynamic character. If any of the alternatives considered is evaluated as being satisfactory, the decision will be made in favor of it, otherwise the search will continue until a satisfactory alternative is found. The behavioral model is using the satisfying rule of decision instead of the maximization rule.

Table no.1 Elements of standard model of choice and behavior model of choice developed by Herbert Simon (Source: Author's own elaboration)

Decision Element	Standard model	Behavioral model
Rationality	Global rationality, <homo oeconomicus>	Bounded rationality (substantive and procedural rationality)
Environment	Real	Affected by perception
Choice alternatives	Already known	Searched and created through <Design>
Computational capacity	Unlimited	Limited
Informational level	Exhaustive	Limited
Nature of problem	Given	Represented by man with the help of psychological process (memory, attention, motivation etc.)
Dynamic element of model	None	Aspiration level
Decision rule	Maximization	< Satisficing >
Behavior	Maximizer	Adaptive

2. The inner design

Studies conducted by Amos Tversky and Daniel Kahneman continue on the line started by Herbert A. Simon. By integrating research methodologies specific to psychology and concepts from cognitive psychology, psychology of perceptions and sensations and psychophysics, they studied intuitive judgment under uncertainty, especially errors and causes of these judgments issued by System 1 that limit human rationality. Their stated goal was to understand how people make decisions and behave in a real way and to design a limited rationality map. "Together (with Amos Tversky) we investigated the

psychology of judgments and decisions and assessed their limited rationality. Herbert A. Simon long ago suggested that decision-makers should be seen as having limited rationality and provided a model in which maximizing utility was replaced by satisfaction of utility. Through our research we have attempted to obtain a map of limited rationality by exploring the systematic mistakes that separate the judgments that people make and their decisions. " (Kahneman, 2003, p.1449)

Their first program, entitled *Heuristics and Biases*, began with the observation of how people judge probabilities. Tversky and Kahneman noted that even individuals with advanced academic training in statistics tend to have vague evaluative judgments on probabilities. Thus, in a study on the robustness of statistical results and the reproducibility of research results, the two observed that psychologists did not use calculations to determine a representative sample in their studies, but rather used their own evaluative judgment, often leading to an erroneous estimation of a representative sample, and eventually the inability to demonstrate their own assumptions. The "Small Numbers Law" error (Tversky and Kahneman, 1971) defines the situation where, in estimating the subjective probability of occurrence of an event in uncertainty, an agent considers that "random sampling intuitions appear to satisfy the small number law, which states that the law large numbers apply equally to small numbers. ", That is the belief that small samples taken from a population will be as representative as a large sample. (Kahneman, 2012) This deviation from standard theory draws attention to the fact that the way people perceive, process and evaluate uncertain events differs significantly from the normative model - according to which people use statistical principles in estimating probabilities, even in the context of an advanced statistics training. Deviations from predicting probabilities in an objective manner appear to be systematic and difficult to eliminate, people seeking to substitute cognitive effort and information ellipsis by using different heuristics.

In addition to breaking the statistical rules in evaluating judgments, Tversky and Kahneman noted that people tend to have two types of answers to their decision making problems, one fast and one slow. The evaluation judgments belong to the so-called System 1 found between automatic operations of perception and operations controlled by the logical (elaborated) thinking of System 2. System 1 generates intuitive judgments or impressions that are at the boundary between perceptions generated by perception and the resulting evaluation judgments of System 2. The properties of perceptions are also characteristic of the intuitive judgments of System 1, but unlike these first they do not depend on the present stimulation, and can be evoked by language. System 1 contains associative memory - its nucleus, which distinguishes deviations from norms and seeks a causal interpretation of the facts. Sometimes, due to cognitive ease, System 1 replaces the required response with variants that come to mind more easily. This type of answer, heuristic, is more elaborate and more accessible, often correct, but errors can also occur. It cannot be educated, but it is possible to recognize the elements that lead to error, and once identifying them, it is possible to use System 2 to overcome them. The latter is the one which articulates evaluation judgments and makes choices, but often only approves or rationalizes ideas and feelings generated by System 1. Its use causes slow, deliberate thinking. (Kahneman, 2012)

The interaction of the two is characterized by the omnipresence of System 1 which continually produces suggestions for System 2, evaluating them and accepting them, transforming them into voluntary opinions and actions. It also monitors the behavior and intervenes when an error is detected. If System 1 is experiencing difficulties, it calls System 2 for more detailed processing. (Kahneman, 2012) Although more primitive, System 1 can respond to complex problems by migrating through System 2 learning solutions. An example of this is the professional chess player who can use his thinking templates in his decisions instead of evaluative judgments. Due to the ease with which System 1 operates, quick and spontaneous it can issue false intuitive judgments or may perceive relationships where it is not. As a consequence, "different framing of the same decision or judgment problems can activate different mental processes" (Kahneman and Tversky, 1996, p.583) resulting in different intuitive decisions and judgments.

All these cognitive illusions were studied by Tversky and Kahneman using analogies to the psychology of perceptions, and the subjective representations of reality, as well as the erroneous perception of certain objective stimuli, were studied with the help of psychophysics. The presence of these subjective interpretations of reality means that "The main characteristic of the agents is not that they have a vicious thinking, but they usually behave intuitively. The behavior of these agents is not guided by what they can calculate, but by what they see at one point." (Kahneman, 2003, p.1469)

The essence of dual models is the idea that in some situations people use an analytical system based on rules and a large computational load, while in other situations shortcuts such as heuristics, are preferred. Their use is frequent and is an effective way of using resources, which often does not lead to optimization, but to satisfaction. Sometimes, however, they can lead to systematic mistakes called biases. In other words, heuristics can be seen as a good or bad solution depending on the situation. In order to avoid errors in intuitive judgments, we must understand their cause and the reason why System 2 did not intervene to detect and correct them. Tversky and Kahneman argued that the psychological study of systematic and heuristic errors can make light in psychological processes that support perception and judgment, and by knowing their causes, agents can reduce the frequency of occurrence of errors in risk judgments.

Assessments in uncertainty conditions belonging to System 1 take the form of subjective probabilities or intuitive judgments and are mediated by several mental operations called heuristics of judgment. (Tversky and Kahneman, 1974) The two authors identified three such heuristics used by agents in evaluative judgments in situations of uncertainty: the representativeness heuristics, availability heuristics, heuristic adjustment and anchoring (Kahneman and Tversky, 1972; Tversky and Kahneman, 1973; 1974) Although they are often used as shortcuts in decision making processes under uncertainty, all three heuristics lead to systemic errors for each of them. (Tversky and Kahneman, 1974, p.1124)

Representativeness heuristic describes the situation in which in estimating the subjective probabilities an agent basis his judgment on how A is representative of B. Thus, if A contains traits found in B, then the probability of it belonging to B is very high. Otherwise, the subjective probability will be very low. (Kahneman and Tversky, 1972; Tversky and Kahneman, 1971, 1974, 1984) The uncertainty judgment based on

representative heuristics applies a higher probability if the element considered is perceived as a prototype. Thus, if in the description of a person there are elements common to librarians, the subjective probability given by agents to this person to be part of this community is very high. (Tversky and Kahneman, 1974)

The second, the availability heuristic, describes the situation where "people estimate the frequency of a set or the probability of an event depending on the ease with which I come to mind examples or events related to them." (Tversky and Kahneman, 1974, p.1127) The subjective probability attributed to the event or its frequency will be even greater as its availability is greater. Usually, events that are part of large crowds have a high degree of availability. Probability and frequency are differently affected by availability.

The adjustment and anchoring heuristic describes how the estimated subjective probability of agents is affected by a given initial value: "In many situations people make estimates starting from an initial value - or starting point, which is then adjusted to provide the final answer. The initial value or the starting point can be suggested by the formulation of the problem or it may be the result of a partial computational process." (Tversky and Kahneman, 1974, p.1128) Systematic errors occur in the evaluative judgment when the starting point adjustments are insufficient, which is why different starting points may lead to different subjective estimates, the latter depending largely on the initial value. This phenomenon is called anchoring.

All three heuristics result in systematic errors that are unrelated to motivational factors and are not affected by the introduction of rewards and punishments. Moreover, not only ordinary people are predisposed to errors, but also specialists, who due to the knowledge of statistical laws should be able to recognize and correct them.

3. The outer design

The outer design of a decision making is identical with architecture of choice. The term, belonging to Thaler and Sunstein (2016), defines the context in which people make decisions and "reflects the idea that there are several ways of presenting a choice to a decision-maker, and what he chooses depends very much on how the choice is presented." (Johnson et.al., 2012, p. 488) The architecture of choice refers to all the contextual tasks and features associated with the decision that have the potential to influence the information to be used in making the decision or how it will be processed including the nature decision - willingness to pay, choice or simple classification of options according to preference; number of attributes, alternatives or results; the presence of time pressure on the decision; the way the information is organized and the correlation between the attributes of the options. The goal of the architecture of choice is to change people's behavior for better and approaching their decisions with the ones they would have taken if they were to have a global rationality.

Thaler and Sunstein (2016) are supporters of the idea that the strategic design of public policies and not only can increase people's rationality in making decisions. Such situations where people's decisions can be improved, can be encountered in many areas of human behavior, from daily consumer decisions, to decisions about choosing a home or even a life partner.

Thaler and Sunstein (2016) support six principles for achieving a good architecture of choice: preventing mistakes, implicit choices, feedback, identifying, structuring complex choices and incentives. Preventing mistakes is the simplest method of the architecture of choice, based on the idea that people are predisposed to mistakes. With this in mind, the architect of the election will have to observe how people are wrong. The nudge may take the form of a luminous signal as if one of the occupants of a car forgets to put his seat belt, or by inserting a secondary task before completing the main task as that of when you need to raise the card before the cash from a money machine, the use of different shapes and colors for nozzles and infusion connectors could also reduce medical errors in anesthesia. This type of intervention is recommended for frequent and repetitive decisions of System 1, these habits being often subject to forgetfulness due to cognitive automatisms.

The default options are another method used by architecture of choice. This method works because of people's predisposition for inertia and preference for maintaining the current status-quo. Endowed with the two inclinations, "many people will opt for any variation that imposes the least effort or minimal resilience." (Thaler and Sunstein, 2016, p.141) The implicit option will have more effect as it will be perceived as a recommended or normal action. "The implicit variants are ubiquitous, redundant (...) and inevitable, in the sense that for any existing node of an architectural system of choice there must be an associated rule that determines what happens to the decision maker if he does not nothing. (...) the answer will usually be that if nothing is done, nothing changes." (Thaler and Sunstein, 2016, p.141)

If the purpose is to improve people's performance, the best option is to provide feedback. This category includes the option of immediate viewing of the image after it has been taken with the camera or warnings of imminent situations or threats.

The fourth method used in the architecture of choice, identification refers to the accuracy with which people can establish a relationship between their choice and the state of well-being resulting from it. "A good system of architecture of choice helps people to improve their ability to identify, and as such, to select options for their well-being to be amplified." (Thaler and Sunstein, 2016, p. 152) Whether it is the simple choice of the frosty flavor, such decisions involving several heterogeneous options, in some cases with certain associated risks, require the decision maker to make certain compromises. In order to arrive at a better decision, in this situation people need effective information. The latter can be achieved by making the necessary information more accessible about the various existing options and transforming the numerical information into elements easier to translate into actual use. Structuring complex choices can be an effective method of architecture of choice when the set of options is large, and the attributes of the variants are heterogeneous, varying in several dimensions. In this situation, naturally, the human being, characterized by a limited capacity to process information, makes use of simplification. One of the simplification strategies is that of compensation, in which case the assignment of a high value to an attribute compensates for the low value of another. Another strategy is elimination by aspects. In this case, a top attribute is made according to the preference followed by setting a threshold for each attribute, then removing all options that do not meet the required parity. Repeat the three steps for each attribute until the set of options is

a simple one on which the compensation simplification strategy can be applied. In the case of complex decisions with heterogeneous variants, the role of the architecture of choice is to provide a structure. It sorts the variants according to structures already existing in the human mind such as the alphabet or color wheel. Collaborative filtering in which other people's opinions and judgments are used in sorting and structuring complex sets can also be used to simplify complex decisions.

Incentives, taken from the standard economy, can also be used successfully in designing the architecture of choice. Thaler and Sunstein (2016) argue that an important decision when the architect of choice decides to use incentives is to identify the right person that needs to be incentivized. In order to identify this person correctly, four questions should be asked: "Who uses the product? Who chooses it?, Who pays it? And who takes advantage of it?" (Thaler and Sunstein, 2016, p.160) An important aspect in the use of incentives is their prominence. In making a decision, some incentives matter more than others, and one of the main concerns of an architect of choice is to identify the incentive that has the most impact on the decision and make it as prominent as possible.

4. Conclusions

In the beginning of the 20th century a new theory of human choice was starting to be developed. Herbert A. Simon laid the foundations of it by regarding the process of decision making as being <artificial> and the man as an information-processing being. His view on decision being determined by an inner and outer environment and the way man interacts with them was later studied by Daniel Kahneman, Amos Tversky and Richard H. Thaler. Kahneman and Tversky's work focused mainly on understanding the inner environment and the adaptation mechanism of people, while Thaler studied how the outer environment can be design with the help of choice architecture in order to overcome the limits of rationality.

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