1 Introduction

Behavioral economics looks at the way people make decisions. It can be applied financial and insurance markets, labor policy, advertising, and tax policy, among others. It has helped identify how the way information is presented can influence how people make their choices. The behavioral economics approach is different from the traditional rational-choice models, given that it attempts to describe, rather than assume, some characteristics of behavior. It also recognizes the possibility of individuals with limited information and with limited capacity to make calculations.

Behavior economics impacts both normative (how it should be) and positive (how it is) theories. Normative theorists could make their argument more realistic by incorporating some behavioral traits and positive theorists have new tools available to explain things not previously well explained. However, to embrace the behavioral theory, previous theoretical frameworks would need to be reworked.

This paper summarizes the research that explores the biases between the decisions made by individuals and the optimal choices predicted by conventional rational-agent models.

Specifically, Kahneman describes

- The heuristics that people use and the biases to which they are prone in judging under uncertainty.
- Prospect theory, a model that explains choice under risk
- Framing effects and their implications for rational-agent models In this case, the purpose is to present an unified model of judgment that is related to perception
  * Most judgments and choices are made intuitively
  * Intuition and perception are governed by similar rules
2 The Architecture of Cognition: Two Systems

**Intuition** Comes more spontaneously to the mind. This process is most common in actions and thoughts.

**Reasoning** Is deliberate and requires effort, often involving computation and conscious search.

- Not every thought that comes to mind is expressed in action or words. There exists a monitoring system (a conscious process) that attempts to limit the workings of intuition. The author argues that this process sometimes allows the generation of judgments that might be erroneous.

- Intuition, however, can be associated with either good or bad performance. The advantage of intuition is that it allows for quick and easy responses, but without checking some answers, there is an increased probability of error. Good performance of intuition can be enhanced by prolonged practice, which leads to high skills.

- Stanovich and West (2000) describe a pair of systems in which the most important difference between the two categories is related to the degree of effort in the mental process.

  - Effortful processes (in System 2) can disrupt each other, something that is not that probable in effortless processes that characterize System 1. The monitoring process that filters the ideas that are actually expressed and executed has been associated with System 2.

**Impressions** are not voluntary and need not be verbally explicit.

**Judgments** are always explicit and intentional.

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**FIGURE 1. Three Cognitive Systems**
3 The Accessibility Dimension

Accessibility The ease with which ideas come to mind.

Natural Assessments Attributes that come to mind without intention or effort.

- For example, the evaluation of stimuli as good or bad (that can create aversion or preference to several objects and is not subject to voluntary control).

- Some attributes of objects are more accessible than others (i.e., the average rather than sum of lengths).
  
  - The acquisition of skill gradually increases the accessibility of useful responses and of productive ways to organize information, until skilled performance becomes almost effortless.

- Salience (noticeability) can be overcome by deliberate attention
  
  - Expectations are a powerful determinant of accessibility.

- Uncertainty and ambiguity are suppressed in intuitive thinking and are more related to System II properties (doubt can be interpreted as a mental process of this type).

- Other determinants of accessibility
  
  - Genetic differences
  
  - Properties and presentation of the object, [1]
  
  - Familiarity with the perceived object (associative activation)
  
  - Emotional significance, for example, Investments based on the degree of likeness, insurance based on fear concerns.
  
  - Context

The structure described by the two systems allows interpreting adaptation in two different stages, a short-term process that involves reasoning and conscious thinking, and a long term process that allows effective and quick responses at a low cost, given enough time to learn and acquire skills.

This structure can be compared with that of the rational agent described by economic theory.
4 Changes or States: Prospect Theory

Reference-Dependence Perceptions are made based on the context of the situation.

- In economics, the utility of decision outcomes are typically reference independent—it is determined entirely by the final state of endowment.
  - Kahneman calls this “Bernoulli’s Error”
  - Bernoulli wrote the expected utility theory in a prescriptive fashion (rational people should make decision in this way), while many economists use it in a descriptive way without much justification. There is a considerable difference between the prescriptive decision making and descriptive decision making, but many economists fail to notice it.

- In Kahneman and Tversky’s research, preferences seemed to be determined by attitudes to gains and losses, defined relative to a reference point.

* Notice the value of the function is kinked at the reference point.
* It is also convex in the domain of gains, favoring risk aversion, and concave in the domain of losses, favoring risk seeking.

- The assignment of utility to wealth is an aspect of rationality, and therefore compatible with the general assumption of rationality in economic theorizing.

- For example, Problem 3 (p. 1456)
Two persons get their monthly report from a broker:
  * Annie is told that her wealth went from 4M to 3M
  * Ben is told that his wealth went from 1M to 1.1M

Who has more reason to be satisfied with their financial situation?

Who is happier today?

**Prospect Theory** is concerned with the short term outcomes and has decisions made with respect to the reference point. It is a positive rather than normative model.

**Endowment Effect** is when the value of a good is higher when it is viewed as something that can be lost than when it can be gained.

- The mug example (p. 1457)
  - When half of the participants in an experimental market are randomly chosen to be given a mug and trade was allowed, the volume of trade was about half the amount that would be predicted by assuming that value was independent of initial endowment.
  - Transaction costs do not explain this counterexample to the Coase theorem, because the same institution produced no indication of reluctance to trade when the objects of trade were money tokens.
    * The Coase Theorem says people feel free to move along their indifferent curve from any point to any point.
    * The Endowment Effect shows the error of this theorem, because, when considering moving to another point or not, the loss associated with moving is valued higher than the gain due to loss aversion. So people will not move along their indifference curve. In other words, the initial point matters.

- Experienced traders demonstrate less reluctance– the endowment effect can be reduced through experience.

**Status Quo Bias** is present if disadvantages of the alternatives are more pronounced than their advantages.

### 5 Framing Effects

**Extensionality (Invariance)** The assumption that preferences are not affected by inconsequential variations in the description of outcomes.

**Framing Effects** Where extensionally equivalent descriptions lead to different choices by altering the relative salience of different aspects of the problem.

- Very important when considering policy
– For example, the framing of an epidemic problem (p.1458)
  * Retirement savings accounts
  * Organ donors
  * Insurance policies

• Basic principal of framing is the passive acceptance of the formulation given
• A particularly unrealistic assumption of the rational-agent model is that agents make their choices in a comprehensively inclusive context, which incorporates all the relevant details of the present situation as well as expectations about all future opportunities and risk.

**Narrow Framing** When choices are given in limited context.

• For example, the gain/loss framing of outcomes over the overall wealth, or treating a repeated risk as if it were a one-shot deal.

**Mental Accounting** The process people use to code, categorize and evaluate economic outcomes. Can be subject to cognitive bias and logical fallacies.

**Decision Bracketing** The method one uses to make decisions, can be narrow or broad. Narrow bracketing indicates that an agent makes decisions one at a time. Broad bracketing is when the agent decides in the aggregate

• For example, lottery ticket purchases are found to be increased if the buyer narrowly brackets his decision [2].

### 6 Attribute Substitution: A Model of Judgment

**Heuristics** refers to experience-based techniques for problem solving, learning, and discovery. Where an exhaustive search is impractical, heuristic methods are used to speed up the process of finding a satisfactory solution.

• Examples of this method include using a rule of thumb, an educated guess, an intuitive judgment, or common sense.

1. Representativeness heuristic: people predict a higher probability for a more representative event even though mathematically less likely.

   • For example, “Tom and Linda” experiment (p. 1462).

2. Availability heuristic: people predict the frequency of an event, or a proportion within a population, based on how easily an example can be brought to mind.
• For example, Because media reports extensively about homicide, people rate the chance of death by homicide higher than the chance of death by stomach cancer, even though death by stomach cancer is five times higher than death by homicide.

3. Anchoring heuristic: people assess probability starting with an implicitly suggested reference point (the “anchor”) and make adjustments to it to reach their estimate. A person begins with a first approximation (anchor) and then makes incremental adjustments based on additional information.

• For example, when asked to guess the percentage of Chinese students at Duke University, people who were first asked “Was it more or less than 10%?” might guessed lower values (25% on average) than those who had been asked if it was more or less than 65% (45% on average).

• In general, heuristics are quite useful, but sometimes they lead to severe and systematic errors. (Tversky and Kahneman, 1974, p. 1124).

– Biases from heuristics can be defined by discrepancies between the regularities of intuitive judgments and the principles of probability theory, Bayesian inference and regression analysis.

Attribute Substitution occurs when an individual has to make a judgment that is computationally complex, and instead substitutes a more easily calculated heuristic attribute. When someone tries to answer a difficult question, they may actually answer a related but different question, without realizing that a substitution has taken place.

• Example of attribute substitution in economic decision: Valuing insurance

– Some 10 or 15 years ago when there were terrorism scares in Europe but not in the States, two group of Americans who were about to travel to Europe were offered two insurance options:

  * Group 1: How much would you pay for insurance that would return $100,000 if during your trip you died for any reason?
  * Group 2: How much would you pay for insurance that could pay $100,000 if you died in a terrorist incident during your trip?

– Even though “death of any reason” includes “death in a terrorist attack,” the the second group was willing to pay more than the first group. Kahneman suggests that the attribute of fear is being substituted for a calculation of the total risks of travel. Fear of terrorism for these subjects was stronger than a general fear of dying on a foreign trip.

The three conditions for attribute substitution (Kahneman and Frederick 2002) are,
1. The target attribute is relatively inaccessible. Substitution is not expected to take place in answering factual questions that can be retrieved directly from memory (“What is your birthday?”) or about current experience (“Do you feel thirsty now?”).

2. An associated attribute is highly accessible. For example, someone who has been thinking about their love life and is then asked how happy they are might substitute how happy they are with their love life rather than other areas.

3. The substitution is not detected and corrected by the reflective system.

Conjunction Fallacy a logical fallacy that occurs when it is assumed that specific conditions are more probable than a single general one. In other words, it means assigning higher probability to the conjunction than its components.

- For example, “Linda” (p. 1462)
  - Linda is 31 years old, single, outspoken, and very bright. She majored in philosophy. As a student, she was deeply concerned with issues of discrimination and social justice, and also participated in anti-nuclear demonstrations.
    * Which is more probable?
      - Linda is a bank teller.
      - Linda is a bank teller and is active in the feminist movement.
  - The result of this experiment showed that 89% of respondents chose option 2.
  - From probability theory perspective, which option has higher probability? The probability of two events occurring together (in “conjunction”) is always less than or equal to the probability of either one occurring alone.
    * \( Pr(A \cap B) \leq Pr(A) \)
    * \( Pr(A \cap B) \leq Pr(B) \)
  - Even choosing a very low probability of Linda being a bank teller and a high probability that she would be a feminist, the inequality still holds.
  - Suppose
    * \( Pr(\text{Linda is a bank teller}) = 0.05 \)
    * \( Pr(\text{Linda is a feminist}) = 0.95 \)
  - Then, \( Pr(\text{Linda is a bank teller and Linda is a feminist}) = 0.05 \times 0.95 = 0.0475 \) (lower than \( Pr(\text{Linda is a bank teller}) \)).
  - Option 2 seems more “representative” of Linda based on the description of her, even though it is clearly mathematically less likely.
Affect Heuristic Theory  One’s affect (feelings, emotions, likes and dislikes) can influence his decision-making.

- For example, a strong, emotional first impression can inform a buying decision, even if it does not conform to the logic of economic preferences.
  - Someone seeing a house from the street might decide to buy it immediately upon seeing it, based on the strength of the emotional response to its eye appeal. Advertising is often designed to influence customer emotion.
  - Investor who prefers Google to Apple might decide to invest in Google shares although the analysis predicts that the Apple’s shares will give a higher return.

7 Prototype Heuristics

Prototype for a homogenous set, is made up of the average properties of the members in the set. A prototype is highly accessible, and is often the basis of judgments.

- Extensional attributes stem from the principle of conditional adding. This is unlike prototype attributes which come from averages.
  - Target attributes are usually extensional.

- Because averages are more accessible than summation, people use the prototype attributes instead of extensional attributes.
  - For example, suppose we are going to estimate the monetary value of ten sport cards.
    * The target attribute is the total monetary value while the prototype attribute is the average monetary value.
    * If people are told to estimate the value of a set of ten cards, their judgment will be based on the average value of the cards in the set rather than sum the individual values.
  - We can consider this behavior as a prototype heuristic.

Violation of Monotonicity  When new elements are added to the set, the extensional attribute should be monotonically increasing, while the prototype attribute could be increasing or decreasing.

- If the prototype attribute (average) is decreasing, people will intuitively think that the target attribute (summation) decreases despite being additive and monotonically increasing.

- Example 1. Sports Card experiment
Two groups of people were asked to value a set of sport cards.

The set that group 1 received consisted of ten cards in good condition, and the set group 2 received included the same ten cards in good condition plus three cards in poor condition. Each card had some monetary value.

The result: The average valuation given by group 1 was significantly higher than that of group 2, even though the true value of set 2 should be strictly greater than that of set 1.

* The value of the set is an extensional attributes, akin to sum.
* Assume the value of the set is the sum of the values of all its members, or:
  \[
  V(\text{set 1}) = V(\text{good card 1}) + V(\text{good card 2}) + \ldots + V(\text{good card 10})
  \]
  \[
  V(\text{set 2}) = V(\text{good card 1}) + V(\text{good card 2}) + \ldots + V(\text{good card 10}) + V(\text{poor card 1}) + V(\text{poor card 2}) + V(\text{poor card 3})
  \]
* As we can see, since the second set has the same include every member of set 1 plus three additional elements whose values are positive, \(V(\text{set 2})\) should be greater than \(V(\text{set 1})\). However, when prototype heuristic takes place, the sum is substituted with the mean.
  \[
  \text{The three cards in poor condition reduce the average value of set 2, thus set 2 is valued lower than set 1.}
  \]
* When the two sets are presented at the same time and are jointly valuated, people always value set 2 higher than set 1.

Example 2: The Linda Problem

* The probability is an extensional attribute.
  * If people substitute an extensional variable with a prototype variable, they could violate monotonicity.
* With a prototype heuristic happens, people judge the left hand side to be less than the right hand side.
  * The result is even more striking when we consider that the Linda experiment was conducted transparently. That is, each participant evaluate \(Pr. (\text{Linda is a bank teller})\) and \(Pr. (\text{Linda is a feminist bank teller})\) at the same time, but most participant still thought the latter was greater than the former.
* The reason is that it is not obvious that probability is an extensional attribute.

Extension Neglect If prototype attributes are used in lieu of the extensional variable, the extension of the set is usually neglected in a judgment.
• Example 3: Scope neglect experiment:
  – Three groups of test subjects were asked to provide the amount of money they were willing to donate to save a certain number of migration birds.
  – The numbers of birds the three groups received were 2,000, 20,000 and 200,000, respectively.
  – The result: The average amounts of money the three groups are willing to contribute were almost the same, regardless of the number of birds that would be saved. It is another prototype heuristic.
    * The target attribute is the willingness to pay (WTP), an extensional attribute that depends on the number of birds.
      · WTP(saving n birds) = n * WTP(saving one bird)
    * When the number of birds that will be saved increase, the willingness to pay of saving those bird should also increase. However, the result of the experiment implies that people based their judgment on the prototype attribute (WTP of saving one bird), even though they were told the target attribute was extensional. In other words, the scope of the set was neglected.

• Example 4: Duration neglect experiment (p. 1465)
  – The structure is the same as in previous examples.
    * Pain (procedure A) = Pain (period 1)
    * Pain (procedure B) = Pain (period 1) + Pain (period 2)
  – The first period in the two procedures were almost identical in the sense that they had the same length and generated the same level of pain to the patients. Only procedure 2 had a second period, which generated a lower but still positive level of pain.
    * The procedure B received a more positive evaluation from participants than A did, even though it brought more pain to the patients.
  – The reason is that people use average instead of sum to make evaluation.
  – Specifically, the prototype attribute in this experiment was shown to be the average of the pain received at its peak and the pain in the end of the procedure, because they were most accessible from the patients’ memories.

• There are other examples of prototype heuristic mentioned in the paper. The structure of experiments and the biases shown are very similar to those discussed here.
8 The Boundaries of Intuitive Thinking

- Most decisions are made largely under System 1. Although intuitive judgments are useful in most contexts, they usually come with biases and errors. When does the logical, rule-obeying System 2 bound the intuitive thinking?

- Recent studies find the monitoring and corrective function of System 2 works better when a person:
  - Has no time pressure
  - Involves in only one cognitive task at one time;
  - Performs tasks in the evening if he is a “morning person”
  - Is not in a good mood
  - Has high intelligence level
  - Has more traits needed for cognition
  - Has more exposure to statistical thinking

**Joint Evaluation** is a process of “choosing by liking” instead of “choosing by rules”

- In the baseball card valuation experiment (p. 1467), test subjects value card set 1 higher than card set 2 when the two sets are valued separately.
  - The result is an example of violation of monotonicity.
  - When the two sets were jointly valued, set 2 was always valued higher than set 1, showing the bias was eliminated.
  - As shown in the example, whether people use rules to make choice depends on the context.

- Kahneman points out there are two distinct modes of choice: “choosing by liking” and “choosing by rule.” The normal process of decision making, consistent with prospect theory, is “choosing by liking.”

- For example,
  - The first group of people was presented with the two questions and was asked to answer both
    * Decision 1: Choose between A. sure gain of $240 and B. 25% chance to gain $1,000 and 75% chance to gain nothing
    * Decision 2: Choose between C. sure loss of $750 and D. 75% chance to lose $1,000 and 25% chance to lose nothing
  - The answers given were consistent with prospect theory. Most people choose A and D.
The second group is asked to answer the following question:

* Chose between AD. 25% chance to win $240 and 75% chance to lose $760 and BC. 25% chance to win $250 and 75% chance to lose $750

It is easy to see that the option BC dominates option AD. All participants in the experiment choose BC (choosing by rule). However, BC is just the combination of B and C in the first set of decisions. In other words, most people in group 1 chose the dominated option (choosing by liking).

The reason is that they did not jointly evaluate all options in the two decisions, even though all the options were transparently given. The dominance of BC to AD is not highly accessible when the options are written separately. When they are already combined in the presentation, the dominance relationship is highly accessible.

- Studies of dominance in the joint-evaluation design suggest
  - Choices that are governed by rational rules do exist, but
  - these choices are restricted to unusual circumstances
  - and the activation of the rules depends on factors of attention and accessibility

- Increasing the use of System 2 can be done in the following ways,

  **Salient Cue** The monitoring and corrective functions of System 2 are very limited. Presenting a question with a salient cue can initiate System 2 when it previously would not be used.

  - Numerous studies support that
    * The subject will detect the misweighing of some aspects of the information depending on the salience of the cue to the relevance of that factor;
    * The subject will try to correct the detected misweighing;
    * The correction is likely to be insufficient, and the judgment is likely to remain biased. For example, in the prototype heuristics, if the cue is salient (“please pay attention to the scope of the set”), subjects will attempt to correct the errors in impression, but the final decision could remain biased.

  **Financial Incentive** It is generally believed that if the financial consequence of a decision is large, the cognitive biases are unlikely to affect the judgment. However, numerous studies have confirmed that financial incentive is not an effective way to stimulate the functions of System 2.
One explanation is that attention does not guarantee rationality. People usually pay more attention to decisions with large outcomes, but those attentions tend to be ineffective.

In particular, when large financial consequences are at stake, the cognitive is expended on reinforcing the decision already made, which will not necessarily improve the quality the decision. Additional cognitive effort might lead to decisions inferior to the basic intuitive judgment.

9 Discussion

9.1 Behavioral Economics

- Behavioral economics, which links economics with psychology, relaxes some of the traditional assumptions about how individuals act and the values they hold. The behavioral approach recognizes that people do not always act in ways that maximize self-interest, and that they do not always have perfect information on which to base decisions. Also, how an issue is framed affects individual response.

- Behavioral economic approaches may not be applicable to all regulatory, program and policy initiatives. But where application is possible, the government action may be completed more efficiently and the outcomes may be more representative of society, as a result of better information made more accessible to decision-makers.

- The use of behavioral economics in public policy shows promise, as discussed in The Economist [3]. In the article, we can learn several examples how behavioral economics-based policies could improve the effectiveness of government such as increase the income tax revenue and increase the effectiveness of energy efficiency program.

9.2 Conclusions

- There are several systematic biases that separate the beliefs that people have and the choices they make from the optimal beliefs and choices assumed in rational agent model. Therefore, translating the economic model into real world implication should be done carefully.

- This paper presents a different agent which uses more intuition (System 1) rather than reasoning (System 2). The central characteristic of agents is not that they reason poorly but that they often act intuitively. And the behavior of these agents is not guided by what they are able to compute, but by what they happen to see at a given moment.

- Several important subjects developed from this paper are:
Intuition and reasoning are alternative ways to solve problems. Intuition resembles perception. People sometimes answer a difficult question by answering an easier one instead. The processing of information is often superficial, that categories are represented by prototypes.

References

