

DECISION-MAKING, RATIONALITY, AND HUMAN ACTION

Julio Alfonso González-Mendoza¹, Jorge de Jesús Cañizares-Arévalo², Maribel Cardenas-García³

¹PhD in Business Administration, Director Grupo de Investigación Zulima Sciende, Orcid: <https://orcid.org/0000-0001-6329-3347> E-mail: alfonsogonzalez@ufps.edu.co, Universidad Francisco de Paula Santander

²Master in Political Science, Director of Research Group Rotã, Orcid: <https://orcid.org/0000-0002-7838-4695> E-mail: jjcanizaresa@ufpso.edu.co, Universidad Francisco de Paula Santander Seccional Ocaña

³PhD in Education, Research Group Rotã, Orcid: <https://orcid.org/0000-0003-3404-8806>, E-mail: mcardenasg@ufpso.edu.co, Universidad Francisco de Paula Santander Seccional Ocaña

Abstract

Decision-making in organizations, due to its complexity, requires a systemic and rational process; however, there are mental traps called heuristics or cognitive biases, which make the individual ignore rationality, and decisions are influenced by experience, empathy, or desire of the decision maker. The objective of this empirical research is to identify the heuristics present in the decision-making of the executives of the ceramic industry of Norte de Santander, for which a quantitative, descriptive methodology was used, considering three key heuristics: representativeness, availability, and anchoring and adjustment. The results indicate that the decision makers present three types of biases, so it is necessary to be aware of this phenomenon and take actions to counteract the harmful effects on the organization

Keywords: Heuristics, cognitive biases, managerial decision making.

Resumen

La toma de decisiones en las organizaciones, por su complejidad, requiere de un proceso sistémico y racional, sin embargo, existen trampas mentales denominadas heurísticos o sesgos cognitivos, que hacen que el individuo ignore la racionalidad y las decisiones sean influidas por la experiencia, empatía o deseo del decisor. El objetivo de esta investigación empírica es identificar los heurísticos presentes en la toma de decisiones de los ejecutivos de la industria cerámica de Norte de Santander, para lo cual se utilizó metodología cuantitativa, descriptiva, considerando tres heurísticos claves: representatividad, disponibilidad y anclaje y ajuste. Los resultados señalan que los tomadores de decisiones, presentan los tres tipos de sesgos por lo que se requiere tomar conciencia de este fenómeno y acciones que permitan contrarrestar los efectos nocivos para la organización.

Palabras clave: Heurísticos, sesgos cognitivos, toma de decisiones gerenciales

JEL Classification JEL: M14, M21, D38

Introduction

All human beings need to make decisions, from the simplest and most habitual to the most complex and difficult, to adapt to social dynamics, improve their conditions, optimize their available

resources, and form part of a community. These decisions are based on the information they receive, which enables them to interpret the world and convert it into ideas, through conscious rationality or intuitively, instinctively, or sensitively.

In the business world, decisions are expected to be made rationally, through an exhaustive analysis of the information and its environment, trying to create scenarios, with the maximum level of certainty and reliability. However, despite all the forecasts that can be made through rational and conscious analysis of a given situation, there are mental shortcuts, based on previous experiences or perceptions, that distort the decision, ignore the rational process, and make the decision subjective. This phenomenon is known as heuristics or cognitive biases and causes the individual to unconsciously interpret the world according to his or her sensations and intuitions.

Literature reports several types of heuristics, however, for this research they are framed in the taxonomy proposed by [1], which has three general categories, as follows: a) representativeness heuristics; b) availability heuristics; c) anchoring and control heuristics.

Representativeness heuristics consist of an individual's tendency to stereotype. A manager with representativeness may believe that the company's future will be positive because the past was positive, based on judgments of a favorable situation in the past that he or she wishes to repeat. With representativeness, the objective attributes of probability are replaced by the more accessible attribute of similarity, i.e., prototypes or stereotypes are generated that are more understandable and easier to understand when making decisions, although they are subjective and unreliable.

For availability heuristics, these constitute a mental mechanism to determine how likely it is that an event will occur, based on the recurrence and ease with which the memories or experiences associated with that event come to mind. In the complexity of a modern company, there is too much information available for decision-makers to process, so they may be tempted to give more importance or weight to what is present and available in memory.

Cognitive anchoring and adjustment biases, on the other hand, are the tendency to rely on the first available information that acts as an anchor and the subsequent information adjusts to it. The anchor or initial information causes the decision-maker to construct judgments and ignore subsequent information, thus incurring cognitive biases.

In this context, this research aims to measure the level of heuristics in the decision-making process of the executives of the ceramic industry of Norte de Santander, for which a sample of 30 of the 72 organizations was taken and the judgment instruments for each type of heuristic were applied.

The article initially includes an exhaustive documentary analysis of the types of heuristics, their causes, and consequences, followed by an explanation of the methodology used to carry them out, and then presents the results found in the fieldwork, contrasting them with the theoretical review and explaining the existence or not of each one of them. Finally, a discussion of the results found is made, concluding that the three types of cognitive biases studied are present in the decision-making of the executives of the ceramic industry of Norte de Santander, and some options are proposed as to how they can be counteracted.

Theoretical Review

Thinking and the construction of knowledge are abilities that distinguish human beings from other living beings, and to make use of this refined attribute, they need to interpret the world, construct ideas about it and make decisions for their adaptation, satisfaction, and social performance. Since Plato's postulates (4th century B.C.) there have been two ways of conceiving the world: the first through conscious rationality and the second through irrationality, instinct, or sensibility. In both cases, the cognitive process is used to understand phenomena and take a position on them.

In the business world, however, decisions are expected to be made consciously and rationally, making use of the resources and information available, so that decisions are timely and reliable. In this sense, by the 1970s, through the Subjective Expected Utility theory, it is proposed that individuals can fully understand the world, making use of their rationality by evaluating different options to find the best course of action and ignoring the subjective nature of the human being. In this model of decision making, especially applied in economics, it was considered that a manager can choose an alternative, evaluating the probability and utility of each

possible outcome. The option chosen will be the one that offers the optimal probability and the best utility [2]. Determining probability and utility is quite difficult, but the theory assumes that decision-makers know the method and apply it correctly.

More recently [3], it was proposed that in situations of high uncertainty and complexity, mental shortcuts are involved in making decisions without processing any rational thought and that individuals use their perceptions and previous experiences to predict values and reduce them to simpler judgments [4] without having to make rational calculations and evaluations, but rather based on their cognitive capacity and accumulated experiences. This phenomenon is known as heuristics or cognitive biases.

In this sense, a cognitive process is assumed that transcends the evaluation of conditions and operates the perceptions and experiences of the individual, especially in situations of uncertainty and complexity. Thus, if there is a positive experience or reference to a situation, people like it and value positively the effects it may have, while if there is an aversion, the negative references to it will be greater [5].

In the line of discussion [6] considers that perceptions and experiences, on the one hand, and rationality, on the other, are different sources of knowledge and have opposite functions, configuring two types of systems through which human beings interpret reality: The first system is emotional, affective, intuitive, spontaneous and evolutionary; and the second system is rational, analytical, reflective and arose in human beings through their evolution [7].

In the first system, processes function as 'heuristics' that help make decisions relatively easy, even on complex problems, but they can also become traps, overlooking necessary complexities and nuances. This phenomenon can be harmful to the decision maker, but on the other hand, affect is important for capturing the meaning of events that numbers often cannot convey [8]. Emotional and intuitive responses to risk should not be seen as heuristics that tend to be biases with harmful effects; rather, they should be seen as sources of valuable information when it comes to judging the moral acceptability of risks.

In the second system the processes are more reliable, but come at the cost of being slower, as

they require more reflection ([9]; [10]; [11]), is what is known as a rational model of decision-making, in which states or results of various types are approved or qualified and which require a process in a logical order and presuppose the search for perfection, which makes it a factor that delays decision making.

Now, within organizations it is normal that decisions are made in the search for the best strategy for the company to find a competitive advantage, alleviate the dangers that lurk, and adapt to market changes ([12]; [13]), but these decisions, which are spearheaded by a leader or management team, are influenced by the cognitive biases of the individuals that comprise it.

Entrepreneurs, leaders, managers, or CEOs have to deal with uncertainty, ambiguity, and pressure at the highest level, which makes decisions prone to heuristics, especially in the case of those who do not have greater experience, therefore, their decisions are more affected by cognitive biases and may have greater uncertainty and vulnerability [14]. For Nassar and Muñoz [15] the experience of the decision-maker represents a high degree of subjectivity and must be taken into account as an essential factor when making the evaluation.

Heuristics consist of simple and efficient rules that explain how individuals make decisions and solve problems, through shortcuts based on experience or intuition, in complex situations, where there are not enough elements to analyze due to lack of information or because they cannot discern it. These rules work properly in most cases, but in others, they give rise to cognitive biases, which are the effects generated by shortcuts or heuristics, which can be favorable or unfavorable in decision-making [16].

In complex situations, impressions, feelings, confidence in their beliefs, and preferences, i.e., intuitive judgments, can lead people to make possibly incorrect decisions, even knowing and recognizing that the rules of rational choice are violated [17]

Now, some theorists such as [18], make a distinction between heuristics and cognitive biases, proposing that heuristics are the rules used to evaluate and predict values, and cognitive biases are the effects associated with heuristics. Other authors including [19] y [20], The two terms are used interchangeably. In this paper, the same

concept will be used for both constructs, since the objective is to explain the existence of a phenomenon that distorts decision-making and to propose strategies to counteract it.

According to the above, heuristics or cognitive biases are presented in different ways depending on factors such as the complexity of the environment, the subjective load of the decision-maker, the knowledge of the problem to be decided, the information that supports the decision, the experience of the decision-maker, the expertise and connection of the work team, among

others. In this sense, there are several attempts to classify and explain them, and for this paper, the taxonomy proposed by Bazerman and Moore [1] is used, who proposed three heuristic categories, as follows: a) representativeness heuristics, b) availability heuristics, and c) anchoring and adjustment heuristics. Some of them have further subdivisions that are discussed in this part of the paper and applied in the fieldwork.

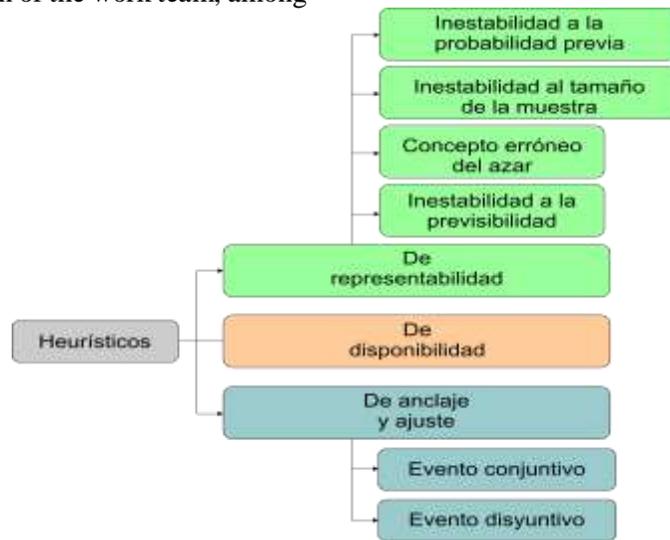


Figure 1. Taxonomy of heuristics in decision making. Description in original Spanish language.

Note: Source, Bazerman and Moore [1]

Representativeness Heuristics

Representativeness is the tendency to create stereotypes; decision makers substitute the objective attribute of probability with the more accessible attribute of similarity, i.e., they generate more understandable and familiar prototypes or stereotypes based on their intuitive judgments and experiences. This cognitive bias judges the probability of an event based on the degree of representativeness of a given group or process [21].

Biases based on a representativeness heuristic are the following: 1) insensitivity to prior probability, 2) insensitivity to sample size, 3) misconception of chance, and 4) instability to predictability.

Instability to prior probability. This heuristic consists of assigning a probability of occurrence of a phenomenon or category, taking into account

only the new information and ignoring the previous one. The individual overlooks the prior probability of the results because he/she believes that these data do not represent or have any impact on the current problem.

Sample size instability. Individuals are likely to observe 60 percent of some events in a smaller sample size than in larger sample size [1]. People try to generalize the population from small samples, obviating the laws of statistics, which means that from very small samples one cannot infer an attribute to a population. This leads to errors where conclusions are not firm or reliable due to a reduced number of observations.

In market research, this cognitive bias can occur when the concept of sampling error is used inappropriately. For example, if a study shows that 60% of customers prefer a product, it is taken for granted without analyzing whether the

information comes from a survey of 100, 500, or 1,000 individuals.

Misconception of chance. It is about believing or taking for granted that a short sequence of random events represents an attribute or behavior of a process. If one considers the tosses of a coin for heads (A) or tails (B), individuals see the sequence a-b-a-b-a-b as more probable than the sequence a-a-a-b, which does not represent the fairness of the coin (Kahneman and Tversky, 1972).

According to Tversky and Kahneman (1986), people pay little or no attention to predictive value considerations. When making a prediction about the future profitability of a firm, and knowing its description, they are likely to assign high future profitability if the description is favorable. People tend to judge in terms of how favorable the description of the company is; a favorable description would imply higher future profitability.

Instability to predictability. Predicting the future without considering the reliability or predictability of the information, taking into account only the favorability of the description, so that predictions are insensitive to the reliability of the evidence and the expected accuracy of the prediction [22]. A company's projection team will likely assign better predictability compared to another whose description is less favorable, but this should not occur since the description is not a reliable source of predictability and should rely on rational judgment based on statistics. If statistical predictability is zero, the same value should be given to any projection regardless of its description [23]

Availability Heuristics

The availability heuristic is a mechanism that the mind uses to determine how likely it is that an event will or will not occur, based on the recurrence of memories or experiences associated with that event. The decision maker tends to evaluate the frequency or probability of an event occurring based on the ease with which memories of similar cases come to mind [18], availability means the ease with which particular cases or circumstances can be recalled.

Like representativeness heuristics, availability heuristics are useful for inductive reasoning for the following reasons: cases in a larger category

are more quickly and vividly recalled than cases in a smaller group, probable events are easier to imagine, and repeated events with clear links between cause and effect can be better recalled, however when availability is not associated with the objective probability of the event, a systematic judgment error occurs [24]

Anchoring and Adjustment Heuristic

This type of heuristic refers to the process in which people make estimates starting from an initial value, with progressive adjustments until they find a final answer or estimate that is typically insufficient [21]. When managers make decisions under uncertainty, they are prone to use externally available information as anchors, and then adjust according to their estimates [25]. When making an estimate based on initial data or information, the resulting inference may be biased.

Conjunctive Event and Disjuncts. This is the tendency to overestimate the probability of conjunctive events and underestimate the probability of disjunctive events because the starting point, in general, is insufficient, therefore, the final estimates remain closed to the probabilities of the elementary events; it is relevant to mention that, in a conjunctive event the overall probability is higher than in a disjunctive event, but as a consequence of the anchoring in a conjunctive event the probability is overestimated and in a disjunctive event it is underestimated [26]. This phenomenon leads to judgment biases due to insufficient anchoring and adjustment [27]

Methodology

The methodology used is quantitative, descriptive, and correlational, supported by documentary analysis and direct observation of decision-making and cognitive biases of companies in the ceramic sector in Norte de Santander (Colombia). According to [28], In Norte de Santander there are 72 companies in the sector, distributed especially in the municipalities of the Metropolitan Area of Cúcuta. The sample taken for this study was 30 organizations, favoring large companies. To determine the level of heuristics in decision-making among the executives of the organizations, several questions were designed and the participants were asked to solve them. The

tasks were designed to elicit biases or heuristics, as used in the study [29], and allow the measurement of representativeness, availability, and anchoring and adjustment biases.

Results

Heuristic test of representativeness

Insensitivity to prior probability. To test for the presence of prior probability insensitivity in the decision-making process, this study simultaneously used two scenarios as judgment tasks, and only one of them reflects the stereotype of a trader, as shown in Table 1. To test whether there is a difference between the responses to two judgment tasks, the t-test was applied for related samples.

Table 1. Judgment task to measure prior probability insensitivity heuristic.

Suppose your company has 100 customers whose occupations are tradesman or builder. The following describes the profile of two customers who have been chosen at random.
Mr. X , who is 45 years old, is quite ambitious, has a nose for business, spends a lot of time reviewing possibilities for new investments, and is not very interested in political issues
Question A: If 70% of the 100 customers are merchants and 30% are builders, what is the probability that Mr. X is a merchant: Answer () %
Question B: If 30% of the 100 customers are merchants and 70% are builders, what is the probability that Mr. X is a merchant: Answer () %
Mr. Z is 30 years old, married, with no children, a friendly and mild-mannered individual who is seen as an empathetic person by his friends and work colleagues.
Question A: If 70% of the 100 customers are merchants and 30% are builders, what is the probability that Mr. Z is a merchant: Answer () %
Question B: If 30% of the 100 customers are traders and 70% are builders, what is the probability that Mr. Z is a trader: Answer () %

Examination of the difference between the prior probability and the estimated probability showed that respondents made judgments considerably away from the prime rate, regardless of whether or not a merchant profile was presented. In the first scenario, reflecting a typical trader, when the trader percentage is 30 percent, the mean estimated probability was 69.56 percent; and when the trader percentage was 70 percent, the

mean estimated probability was 36.96 percent. In both cases, it was found that there was a significant difference between the prime rate and the estimated probability ($t=6.60$, $gl=29$, $p<0.01$ when the prime rate was 30 percent; $t= - 3.34$, $gl=92$, $p=0.01$ when the prime rate was 70 percent) (Table 2)

Table 2. Judgment on the probability of being a merchant.

Constructor (%)	Merchant (%)	Measure	Standard Deviation	T Student
70	30	69.56	16.2	6.60***

The stereotype of a trader was given (First scenario)	30	70	36.96	21.4	-3.44***
The stereotype of a trader did not occur. (Second scenario)	70	30	59.26	22.9	2.22**
	30	70	38.23	21.8	-2.95***

Note: Ho: mean = 50; Ha: mean! = 50; Degrees of freedom (gl) = 29; Pr(|T| > |t|) < 0.01***; Pr(|T| > |t|) = 0.05**; Pr(|T| > |t|) = 0.10*

In the second scenario, which does not have the merchant profile, the mean estimated probability was 59.26% when the percentage of merchants is 30 percent; and when the percentage of merchants is 70 percent, the mean estimated probability was 38.23%. Both cases showed that there is a significant difference between the prime rate and the estimated probability (t=2.22, gl =29, p<0.01 when the prime rate is 30 percent; t= - 2.95, gl =29, p<0.01 when the prime rate is 70 percent) (Table 2).

Both scenarios, one of which presents a merchant stereotype, are then compared. The results were as follows: when the prime rate of merchants was 30 percent, the proportion was 69.56 percent versus 59.26 percent, while when the rate of merchants

was 70 percent, the proportion was 36.96 percent versus 38.23 percent.

The results indicate that the prime rate information does not have a large effect on the judgment of the respondents, i.e., the probability judgment is based on how the scenario posed is representative of the traders and no prior probability is used in the judgment. Additionally, this finding is consistent with the study result that prior probability is ignored even when the description of a typical trader is presented, which is ultimately interpreted as the presence of the representativeness heuristic, due to the ignorance of prior probability.

Sample size instability. To test for the presence of sample size insensitivity in managerial decision-making, the Tversky and Kahneman (1973) scenario was used, as shown in Table 3.

Table 3. Judgment task to measure sample size instability

A company has two branches: a large branch and a small branch. The average number of customers visiting the large branch on a typical day is 45, while 15 customers visit the small branch. Of all customers, the percentage of men is 50%, with a small difference depending on each day.	
Question: Based on the annual data, which branch would be most likely to have days with 60% of male clients?	
Choose only one answer	
Answer: Large () Small () Approximately the same ()	

To test the difference in frequency between the correct answer option (small company) and the incorrect answer options (large company and

about the same), the χ^2 test (Chi-square test) was used).

Table 4. Type of company that has the most days with 60% of male customers

Classification	Result	Expected frequency	Chi-square value
Grande	8 26.67%	10	10,51*** (p=0,01)
Small	4 13.33%	10	
Approximately Equal	18 60.00%	10	

The result of the analysis is shown in Table 4; the number of respondents who chose a small company was 13.33%. The rest chose incorrect answers, thus: 26.67% were large companies, and 60% were approximately equal, which shows a significant difference between the response options ($\chi^2=10.51$, $p<0.01$). In addition, it is observed that the answer approximately equal is 60%, which constitutes the presence of a representativeness bias in the decision-making process, due to the insensitivity to the sample size of the executives interviewed.

Misconception of chance.

To test for the presence of heuristics in judging random events, this study presented three different situations involving six customers and asked respondents to choose the response with the highest probability among the three, as shown in Table 5. To compare the frequency of choosing the response with the highest probability among all the response options, the study used the test χ^2 .

Table 5. Scenario based on probability of buying a product

<p>It is known that 50% of the customers who visit your company, to buy product X, actually buy product Y. Among the following cases of six customers visiting your company to buy product X, which is the most likely type to occur?</p> <p>Type A: No Purchase product X - Purchase product X - No Purchase product X - Purchase product X - No Purchase product X - No Purchase product X - Purchase product X.</p> <p>Type B: Purchase product X - Purchase product X - Purchase product X - No Purchase product X.</p> <p>Type C. Purchase product X - No Purchase product X.</p> <p>Answer: Type A (), Type B () Type C (), All are the same ()</p>

Table 6 shows the results for the hypothetical scenario of buying a product and it can be seen that the estimated mean probability for each response option is as follows: for Type A, the estimated mean probability was 50%; in Type B, the

estimated mean probability was 36.67%; and for Type C, the estimated mean probability was 13.33%.

Table 6. Judgment on the composition of customers who can buy a product

Classification	Result	Chi-square value
Type A	15 50.00%	30 (100%) 28,03*** ($p<0,01$)
Type B	11 36.67%	
Type C	3 13.33%	
All are the same	1 0.00%	

The information found shows that there is a statistically significant difference between the three probability means since out of the 30 respondents it was found that 15 chose Type A, 11 chose type B, 3 selected type C and 1 said that all options are the same. The result of the test χ^2

showed that there is a statistically significant difference at $\alpha=0.01$ ($\chi^2=28.03$, $p<0.01$).

From the above explained it is concluded in the findings that the judgment of executives of the surveyed organizations considers Type A to be the

most similar to their beliefs about the random event presented.

Instability to predictability. To test for the presence of instability biases in predictability, this study compared responses to two questions, as

shown in Table 7, one hypothetical question on the evaluation of the country's business policy and the other on the prediction of how small business policy contributes to price stability in the coming years.

Table 7. Judgment task to measure insensitivity to predictability

The following sentences from a research article describe the current situation of a country's business policy. Read the sentence and answer **questions A and B**.

Since the government announced a series of policies regarding small entrepreneurs, product prices have risen, while the purchase price of the technology has remained stable. A sign of this is that bank loans have decreased on a large scale.

Question A: Judging from the above information, I assessed the contribution of policies to commodity price stability.

Answer: score () %

Question B: Judging from the above information, assess how the policy on small entrepreneurs will contribute to price stability over the next three years.

Answer: score () %

To test whether there is any discrepancy between an individual's assessment and prediction in the

decision-making process, the paired samples t-test was used, as shown in Table 8.

Table 8. Evaluation and prediction of business policy

Classification	Mean	DE	T-test
Evaluate the contribution of policies on product price stability.	63.06	16.89	5.35** ($p < 0,05$)
Evaluate how the policy on small entrepreneurs will contribute to price stability over the next three years.	47.66	18.69	

Note: Paired samples t-test was used. H_0 : mean difference = 0; H_a : mean difference \neq 0; Degrees of freedom: 29; $\Pr(|T| > |t|) = 0.01$ ***; $\Pr(|T| > |t|) = 0.05$ **; $\Pr(|T| > |t|) = 0.10$ *

According to the data shown in Table 8, the mean evaluation of the contribution of business policy to price stability was 63.06%, while the mean prediction of contribution to price stability was 47.66%, which means that there is a statistically significant difference ($t=5.35$, $p < 0.05$) between the two responses.

This finding indicates that there is no insensitivity to predictability in the decision-making process in the banking sector, and is inconsistent with the

result that a future prediction changes as a function of the favorability of the current condition. However, it is unreasonable to test for the presence of insensitivity to predictability based solely on the difference in means, considering that many variables must be considered in the evaluation and prediction of business performance and that the perceived effect of policy generally diminishes over time.

of industry executives, this study used two different judgment tasks: a conjunctive event and a disjunctive event.

Conjunctive event. An overestimated probability of a conjunctive event refers to the phenomenon

of overestimating the probability of the whole event when it contains components with high probability (Tversky and Kahneman, 1974). To test the overestimation of a conjunctive event, the scenario shown in Table 11 was used.

Table 2. Trial task to test the overestimation of the probability of conjunctive events.

<p>Assume that the following three factors can predict the growth of Colombia's Gross Domestic Product (GDP) and that the percentage level of accuracy is:</p> <ol style="list-style-type: none"> 1- Economic and institutional stability 90%, 2- International trade 80%; 3- Technological progress 85% <p>Under this circumstance, if only the three factors are used, GDP growth in the coming year could have:</p> <p>Answer: Mark with an X An Accurate Prediction (), Underestimated Prediction (___), Overestimated Prediction (___)</p>
--

Table 12 shows that 13.33% of the respondents believe that an accurate prediction of GDP can be made with the three proposed factors, 26.67% believe that the accuracy would be underestimated and 60% believe that the prediction is overestimated. The Chi-Square value is 65.3, which indicates that there is a statistically

significant difference between the frequencies, therefore, it is concluded that the managers interviewed tend to overestimate the probability of a conjunctive event instead of estimating the actual probability.

Table 12. Judgment of accuracy in GDP prediction

Classification	Result	Expected frequency	Chi-square value
Accurate Prediction	4	13.33%	65.3 (p<0.05)
Underestimated Prediction	8	26.67%	
Prediction Overestimated	18	60.00%	

Disjunctive event. An underestimated probability of a disjunctive event often occurs when measuring the level of risk. The probability of the whole case causing the anomaly increases when there are components that have a low probability (Tversky and Kahneman, 1974). To test the underestimation of disjunctive events, this

research used a scenario in which the probability of bankruptcy of a company is judged (see Table 13). In this scenario, the probability of bankruptcy of a company is based on the sum of the three probabilities, i.e., 14%.

Table 13. Judgment task to test the underestimation of the probability of disjunctive events

<p>The three main causes of company bankruptcy and their probability can be summarized as follows.</p> <ol style="list-style-type: none"> 1) Credit risk: 5% probability, 2) Liquidity risk: 4% probability. 3) Weak earnings: 5% probability. <p>Based on the causes and probability presented, what could be the probability of bankruptcy of an average company?</p>
--

Answer (%)

The responses are classified in three ranges as follows: a) accurate prediction, those responses that are identical to 14%; b) underestimated prediction, those responses that are below 14%; and c) overestimated prediction, those responses

that are above 14%. Next, the differences in the frequency of responses were analyzed employing the χ^2 . The findings are shown in Table 14.

Table 14. Accuracy judgment on causes of company bankruptcy.

Classification	Result	Expected frequency	Chi-square value
Accurate Prediction	4 13.33%	10	63.5 (p<0.05)
Underestimated Prediction	17 56.67%	10	
Overestimated Prediction	9 30.00%	10	

According to the data in Table 14, the executives interviewed were in the range of accurate prediction of 13.33%, underestimated prediction is 56.67% and overestimated prediction is 30%, with a $\chi^2=63.5$, $p<0.05$, which means that there is a tendency to underestimate the probability of disjunctive events in decision making. This is because the post-anchoring adjustment of the detailed information was incomplete, leading to an underestimation of the probability of disjunctive events.

Discussion

The various experiments conducted by Tversky and Kahneman show that human beings make judgments and decisions with limited rationality, loaded with cognitive biases or heuristics. In this context, the objective of this research was to measure the level of heuristics in the decision-making process of the executives of the ceramic industry of Norte de Santander, for which the heuristics of representativeness, availability, anchoring and adjustment were taken as the central axis of discussion.

When inquiring about the instability of the prior probability, it was found that: a) the prime rate information did not exert a great influence on the judgment of the probability of events or cases, which means that the population under study does not adequately use prior probabilities when making decisions; b) decision makers characterize a population, without considering the sample size, assuming that any sample is significant to

represent the population, evidencing that there is instability to the sample size; c) the executives interviewed to estimate the probability of events based on the degree of coherence of their beliefs about events, which implies biases to overestimate the result of a small sample and therefore, there is a misconception of chance; and d) there is instability to predictability when trying to predict the future based on the available information without considering its reliability. Therefore, it is considered that there is a heuristic of representativeness in decision-making.

Regarding the availability heuristic, it was found that the determination of the probability of an event is made based on how similar experiences are recalled, rather than on the frequency of the event, which implies that there is an availability bias. Likewise, concerning the anchoring and adjustment heuristic, it was found that decision makers are persuaded by biases when choosing the probability of conjunctive events and disjunctive events based on insufficient anchoring and adjustment, especially when observing that there were biases of overestimation of conjunctive events and underestimation of disjunctive events.

The fact that, in the decision-making of the executives of the ceramic sector of Norte de Santander, the heuristics of representativeness, availability and anchoring and adjustment are present, may have some implications: (a) it may become a difficulty when making rational decisions regarding strategic design because it would have a greater burden of uncertainty; (b) although the design of business strategies and

policies involves constant adjustments, the presence of heuristics would prevent review and feedback without the subjective burden that may lead to errors; and (c) overestimating or underestimating the probability related to risk, may cause an error in the design of business policies.

Under these circumstances, it is considered that decision-makers in the organizations of the sector under study must fully understand and respond to the cognitive biases presented and their harmful effects, so that they can be addressed and appropriate measures are taken to avoid them. Just being aware of the phenomenon and identifying the most common types of biases and educating decision-makers can provide some benefits and help build strategies to mitigate their effects [31].

Conclusions

By nature, the human being is a decision maker, in such a sense, he faces having to decide usually from the most elementary to the most difficult and complex. Managerial decisions are made based on an adequate analysis of the information and study of the environment, following a systemic process, known as a rational model, in which states or results of various types are approved or qualified, in a logical order that seeks perfection.

Notwithstanding the rigor with which decision-making is approached, in a situation of high complexity and uncertainty, the decision maker makes use of his experience, perception, or intuition to predict values and reduce them to simpler judgments. This phenomenon is known as heuristics or mental shortcuts in which individuals use simple criteria to solve complex problems, which can become traps by overlooking complexities and nuances necessary for a correct decision.

The literature reports various types and taxonomies of heuristics, among which are those of representativeness, availability, and anchoring and adjustment. In the representativeness heuristic, the decision maker changes the objective attribute of probability for the more accessible attribute of similarity, i.e., more understandable and familiar prototypes or stereotypes are generated, based on his intuitive judgments and experiences. With the availability

heuristic, one determines how likely it is that an event will occur, based on the recurrence of memories or experiences associated with it. The decision maker tends to evaluate the frequency or likelihood of an event occurring based on the ease with which memories of similar cases come to mind. In anchoring and adjustment heuristics, decision-makers make estimates starting from an initial value with successive adjustments until a typical response is found, which is usually insufficient and subjectively loaded.

The study showed that the executives of the ceramic industry of Norte de Santander, present the heuristics of representativeness, availability and anchoring, and adjustment, which can result in distorted decisions, so it is essential to be aware of these mental traps and take action to counteract them. The mere fact of being aware that this phenomenon is present provides tools to build strategies to mitigate its consequences.

Finally, some heuristics are more difficult to correct, such as overconfidence and anchoring, which are resistant to logic, decomposition, and the use of training tools, while others, such as illusory correlation, can be eliminated through the use of statistics, probabilities, and logic.

References

- [1] M. & M. D. Bazerman, *Judgment in managerial decision making*, New Jersey: Wiley, 2008.
- [2] N. Cortada, «Los sesgos cognitivos en la toma de decisiones,» *International Journal of Psychological Research*, vol. 1, n° 1, pp. 68-73, 2008.
- [3] D. Kahneman y A. Tversky, «Prospect theory: an analysis of decision under risk,» *Econometría*, vol. 47, n° 2, pp. 263-291, 1979.
- [4] R. Pascale y G. Pascale, «Toma de decisiones económicas: el aporte cognitivo en la ruta de Simon, Allais y Tversky y Kahneman,» *Ciencias Económicas*, vol. 1, n° 2, pp. 149-170, 2007.
- [5] P. Slovic, E. Finucane y D. MacGregor, The affect heuristic. In *Intuitive judgment: Heuristics and biases*, ed. T. Gilovich, D. Griffin, and D. Kahnemann, Cambridge: Cambridge University Press, 2002.

- [6] D. Kahneman, *Pensar rápido, pensar despacio*, Bogotá: Random House Mondadori, 2012.
- [7] S. Roeser, «Intuitions, emotions and gut reactions in decisions about risks: towards a different interpretation of neuroethics.» *Journal of Risk Research*, vol. 13, n° 2, pp. 175-190, 2010.
- [8] G. Loewenstein, E. Weber, C. Hsee y N. Welch, «Risk as feelings.» *Psychological Bulletin*, n° 127, p. 267-86, 2001.
- [9] S. Epstein, «Integration of the cognitive and the psychodynamic unconscious.» *American Psychologist*, vol. 49, n° 8, p. 709-24, 1994.
- [10] S. Sloman, «The empirical case for two systems of reasoning.» *Psychological Bulletin*, n° 119, p. 3-22, 1996.
- [11] K. Stanovich y R. West, *Individual differences in reasoning: Implications for the rationality debate? In Intuitive judgment: Heuristics and Biases*, ed. T. Gilovich, D. Griffin, and D. Kahnemann, Cambridge: Cambridge University Press, 2002.
- [12] P. Bonatti, *Teoría de la Decisión Capítulo 1. La Decisión*, Bogotá: Pearson., 2011.
- [13] O. Williamson y T. Ghani, «Transaction cost economics and its uses in marketing.» *Journal of the Academy of Marketing Science*, vol. 40, pp. 74-85, 2012.
- [14] P. I. N. T. K. & Z. M. Nouri, «Heuristics and biases in entrepreneurial marketing.» *Some new insights*, vol. 5, n° 2, pp. 1-25, 2017.
- [15] J. Nassar y A. Muñoz, «Sistema de apoyo al proceso de toma de decisiones de inversión en tecnología según el modelo de Kepner y Tregoe.» *Pensamiento & Gestión*, n° 21, pp. 49-92, 2006.
- [16] G. Gigerenzer, «How to make cognitive illusions disappear: Beyond heuristics and biases.» *European Review of Social Psychology*, n° 2, pp. 83-115, 1991.
- [17] D. Kahneman, *Thinking, fast and slow*, Estados Unidos: Farrar: Straus and Giroux, 2011.
- [18] D. Kahneman, P. Slovic y A. Tversky, *Juicio bajo incertidumbre: Heurísticas y prejuicios*, Cambridge: Cambridge University Press, 1982.
- [19] C. Schwenk, «Cognitive simplification processes in strategic decision-making.» *Strategic management journal*, vol. 5, n° 2, pp. 111-128, 1984.
- [20] L. Busenitz y J. Barney, «Differences between entrepreneurs and managers in large organizations: Biases and heuristics in strategic decision-making.» *Journal of Business Venturing*, vol. 12, n° 1, pp. 9-30, 1997.
- [21] A. Tversky y D. Kahneman, «Judgment under uncertainty: heuristics and biases.» *Science*, vol. 185, n° 4157, pp. 1124-1131, 1974.
- [22] D. Kahneman y A. Tversky, «Prospect Theory: an analysis of decision under risk.» *Econometrica*, vol. 47, n° 2, pp. 263-283, 1979.
- [23] M. AlKhars, N. Evangelopoulos, R. Pavur y S. Kulkarni, «Cognitive biases resulting from the representativeness heuristic in operations management: an experimental investigation.» *Psychology Research and Behavior Management*, vol. 12, pp. 263-276, 2021.
- [24] C. Chen, J. Cheng, F. Lin y C. Peng, «The role of house money effect and availability heuristic in investor behavior.» *Management Decision*, vol. 55, n° 8, pp. 1598-1612, 2017.
- [25] H. Einhorn y R. Hogarth, «Judging probable Cause.» *Psychological Bulletin*, vol. 99, n° 1, pp. 3-19, 1986.
- [26] A. Tversky y D. Kahneman, «Judgment under uncertainty: heuristics and biases.» *Science*, vol. 185, n° 4157, pp. 1121-1131, 1974.
- [27] M. Bar-Hillel, «On the subjective probability of compound events.» *Organizational Behavior and Human Performance*, vol. 9, n° 3, pp. 396-406, 1973.
- [28] J. Sánchez, J. González y W. Avenzaño, *El Clúster Cerámico. Apuesta de desarrollo socioeconómico de Norte de Santander*, Ecode Ediciones: Bogotá, 2019.
- [29] A. Tversky y D. Kahneman, «Availability: a heuristic for judging frequency and probability.» *Cognitive Psychology*, vol. 5, n° 2, pp. 207-232, 1973.
- [30] J. González, J. Sánchez y M. Cárdenas, *Pensamiento estratégico y reconversión productiva de la industria cerámica de Norte de Santander*, Bogotá: Ecode ediciones, 2019.

- [31] W. Hersing, «Managing cognitive bias in safety decision making: Application of emotional intelligence competencies,» *Journal of Space Safety Engineering*, vol. 4, n° 3-4, p. 124–128, 2017.
- [32] D. Kahneman y A. Tversky, «Subjective probability: a judgment of representativeness,» *Cognitive Psychology*, vol. 3, n° 3, pp. 430-454, 1972.
- [33] A. Tversky y D. Kahneman, «Rational Choice and the Framing of decisions,» *The Journal of Business*, vol. 59, n° 4, pp. 251-278, 1986.