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# Investigating Mental Models of Managers of Research and Technology Funds, in Accordance with the Concepts of Behavioral Economics, for the Development of Innovation Ecosystem in Manufacturing

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**Abstract:** The purpose of this article is to recognize and understand the views and mental models of managers of research and technology funds in line with the new concepts of behavioral economics. Research and technology funds are considered as one of the facilitating arms of the economic system, and make a significant contribution to the sustainable development of the country. The main idea is to recognize the viewpoints and subjectivities of these managers as scientific human resources, who influence the advancement of technology and research of the country, in line with the concepts of behavioral economics. The present study includes 13 senior managers of research and technology funds in 2022, which were obtained by purposive sampling and through in-depth interviews on the propositions resulting from Q methodology. The results show 17 verified propositions and three mental models of managers of research and technology funds related to behavioral economics concepts. The results indicate the existence of cognitive and behavioral bias of representativeness, competence, and confirmation in the first mental model, anchoring and adjustment bias, as well as overconfidence bias in the second mental model. In the third mental model obtained from managers, there are bias of eventuality and data dilution. Finally, by providing nudges (suggestions), an attempt has been made to reduce these biases and to see more efficient management decisions.

**Keywords:** Behavioral Economics, Managers of Research and Technology Funds, Mental Model, Sustainable Development

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Research paper

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## 1 INTRODUCTION

The age of digital and scientific economy has made many changes in the world of organizations, and these organizations have faced intense competition in this dynamic environment. Thus, revitalizing economic life takes place with a view to the competitive advantage and even the survival of economic organizations, the increasingly important ability to adapt to the rapidly evolving environment, introducing the superior strategies and new ideas that meet the needs of society, and ultimately introducing new products behind the knowledge-based and postindustrial economy [1-2]. The turbulent condition of the current economic fields indicates the need to rearrange economic concepts in organizations, decision makers, consultants and other involved people. Therefore, it is important that the effective organs in such proceedings, given the increasing speed of globalization that overshadows all social and economic systems, be equipped with up-to-date knowledge and new economic concepts such as behavioral economics. Because it tries to better describe and analyze our behaviors and decisions by combining economic knowledge with the psychology achievements, and in particular cognitive psychology. These conditions have forced managers to change paradigms to lead their organizations and to make strategic decisions faster [3-4]. Hence, the term behavioral economics is considered as a major challenge for behavioral management researchers and executives. In response to this challenge, many modern researchers have focused on understanding the cognitive aspects and mental structures of related managers. These researchers believe that in order to be familiar with the formation and emergence of behavioral economics concepts, they must go to the models of managers' minds and somehow deal with decoding this black box. In his book Organization Theory, Hatch writes: "The power of words is transferred to those who have better access to or influence on the mainstream discourse" [5]. With a similar argument to those who, as decision makers and main speakers as influencers, bring important results in the economic body of the society with appropriate comments, now if these people know the concepts of behavioral economics and believe them, what will be the result?

Research and Technology Funds are non-governmental institutions established alongside science and technology parks, universities and other research centers and technology development institutions in all provinces, and according to Article 100 of the third program, article 45 of the fourth program, and Article 44 of the Law on Removing Barriers to Competitive Production and Promoting the Country's Financial System, with the aim of creating opportunities for participation and investment of the non-governmental sector. Shareholding financing of research, scientific and technological activities, start-ups, technologists, creators, accelerators and knowledge-based companies up to non-governmental and up to public sectors in these funds is up to 49 percent, and the rest is non-governmental sector, and the upstream policies are based on the encouragement and presence of the majority of the private sector. Also, these research and financial institutions, as a consequence of the Law on the Protection of Knowledge-Based Companies and Institutions, are responsible for financing knowledge-based companies, and for this purpose, they provide various financial services to these companies across four groups of facilities, guarantees, investment and empowerment. So far, knowledge-based companies, whose number has exceeded 6400 companies, have received more than 190 billion Rials of financial services from the Innovation and Prosperity Fund. However, although the number of knowledge-based companies has gradually reached more than 6,400 companies over the past 10 years and is still increasing with a gentle slope, the share of these companies in the country's economy - Gross Domestic Product - is still estimated to be less than 1%, which is significantly far from the desired amount. Increasing the share of knowledge-based companies in the country's economy reasonably requires increasing their number and simultaneously developing the market and selling existing companies. This research tries to identify managers' mental models and provide alternative solutions for managing the allocation of financial resources in the field of research and technology towards sustainable development of the innovation ecosystem, considering the effective and increasing role of research and technology funds, and using new findings from behavioral economics.

Therefore, the main questions of the present research are as follows:

1. What is the mental model of managers of research and technology funds in Iran?
2. What is the categorization of these factors based on Q's methodology? In other words, what mental models do the participants have about the research topic?
3. According to the approaches of behavioral economics, what are the behavioral bias of managers of research and technology funds?

## 2 LITERATURE REVIEW

### 2.1. The Meaning of Mental Models

Although mental models are not actually visible, people can draw them, and their performance makes these models emerge and appear in the real world. In other words, mental models are internal aspects of external realities; This means that these models aim to describe how the surrounding world works, and draw a

manifestation of the external world and the relationships of its different parts in our minds, and we take action based on our conclusions from these phenomena, which in turn, form our behavior. Essentially all human beings, including managers, have an approach in their mind as a personal algorithm to solve problems or make decisions about issues, which is completely influenced by their mental model. Forrester believes that the image of the world around us which we have in our minds is just a model. No one imagines the entire world, government, or country in his mind; rather they only select concepts and relationships between them and use these to represent the real system in their mind. A view of human reasoning is determined according to the concepts of mental models and depends on the type of mental model. Johnson Laird believes that people's mental models are affected by perception, imagination, or discourse. Essentially, the structure of this type of thinking is exactly opposite to the use of solid logics used in judicial and formal theories of reasoning [12]. Laird and Byrne developed the theory of mental models and hypothesized that human reasoning about the phenomena around them is not based on logic, but is based on their mental models. The models are established upon a series of basic assumptions that make them perfectly distinct from other concepts of mental representation of peripheral realities in the psychology of reasoning and reasoning. According to their opinion, each mental model represents a possibility of all the different ways it can happen. Consequently, mental models are symbolic and only consider conditions that are likely to occur. Therefore, according to critical thinking, a proposition that is thought to be wrong may temporarily be displayed as correct. Like other people, managers have their own mental models. For example, the level of experience of two managers causes them to make different decisions in the operational field under similar conditions, because their perceptions of the issue may be completely different. Other factors that can affect decisions include politics, religion, culture, etc. Managers use mental models to refine the huge amount of information and stimuli received from the environment during the day. The working days of most senior executives are filled with meetings, calls, reports, political and economic news, etc. The type of their mental model directs their focus to stimuli they consider more important and relevant. Accordingly, a stimulus may be considered vital while it is not, or vice versa, and this may cause them to make a wrong decision. Mental models are reference frameworks by which managers interpret world phenomena and communicate with the real world through them. Mental models are rich in the knowledge of decision makers about peripheral phenomena, although they vary from person to person. These models, in different ways, affect the decisions that underpin the company's micro and macro strategies. Considering the research conducted in the field of behavioral economics in Iran, it has been observed that so far, no research has been carried out on the mental models of managers of research and technology funds at the country level in accordance with the concepts of behavioral economics.

Aslani et al. by examining the role of mental models in the organizational change process, have concluded that employees who have mental models of goal orientation, monism, balance orientation, pragmatism, and program orientation are more effective in organizational change processes and their acceptance [6]. Salsabil et al. in research titled "Explaining consumer behavior based on cognitive and behavioral sciences", have achieved 3 themes and 16 frequently repeated components. These decisions are categorized as complex decisions, daily decisions, limited decisions, unplanned purchases and instant buying decisions. Finally, they suggest that, considering that a rational human is an unrealistic human being, new observations and experiments can be considered as significant implications in explaining human behaviour [7]. Malekzadeh and Rahimnia (2016), by examining the mental models of managers of knowledge-based companies regarding the meaningfulness of work, using the Q methodology, identified four mental models of managers, which are career expectations, attitude to career, career nature, and individual characteristics. Recognizing these models is used in explaining and presenting appropriate strategies for job design and the path of development and progress of knowledge-based companies [8]. Sarboland (2021), in a study titled "Understanding the role of managers' mental models in innovative work behavior at public organizations using the Q-methodology", analyzes that the five main subjectivities of managers of public organizations in terms of innovative work behavior are examining opportunities, generating ideas, promoting ideas, realizing ideas, and contemplation [9]. Askarifar (2015) in his research has examined the mental model of Iranian entrepreneurs in providing capital to start a business. The findings show that the model of providing entrepreneurial capital in the start-up phase of business in Iran is significantly different from other countries studied. Furthermore, the results show that the laws and governance structure related to business have the greatest impact on the mental model of entrepreneurs [10]. Nasehi Far et al. (2021) in their research investigated the relationship between mental model and open innovation in the sport manufacturing industry, and the results showed that these two factors have a significant relationship with each other. They concluded that without a proper mental model, open innovation cannot be achieved. In other words, if there is a high level of mental ability in a manager's mental model, he can deal with the aspects of open innovation, including entry and exit, knowledge of customer and employee participations, and evaluation of his company; but if he

has more mental involvements in his mental model, he will be less able to engage in open innovation, because he is very busy. In this regard, each mental model determines how managers understand and interpret the company's system, and consequently how they react to it. Managers' mental models can be considered as the basis of innovation and changes in the company [11].

### 2.2. Research Methodology

According to the nature and objectives of the current research, a qualitative approach and Q methodology have been used in it. The Q method is usually considered as the link between qualitative and quantitative methods. Because, on the one hand, the selection of participants is not done through probabilistic sampling methods, but the sample of individuals is purposively selected with a small size, which brings it closer to the qualitative method; and on the other hand, the findings are obtained through factor analysis and in a completely quantitative manner. Also, due to the method of data collection (sorting), it is possible to be more deeply aware of the subjectivity of the participants [12]. The main difference between Q method and other social science research methods is that in Q methodology, people are analyzed instead of variables. The Q method consists of five phases. With library studies in the first phase, the research literature is reviewed, and the background for conducting the next phases is provided. By performing the first phase, the researcher gets a deep understanding of the subject. Using interviews and reviewing documents in the second phase, additional information will be obtained about the issues relating to the research. In the Q method, the sample of people is selected from those who have a special relationship with the research topic. In this study, the sample was selected from the managers of research and technology funds in the country. Lincoln and Guba state that in a carefully guided study in which sample selection is evolutionary and sequential, a saturation point can be reached with about 10 participants. Coyle states that if the purpose of the interview is to explore and describe the beliefs and attitudes of the interviewees, a sample size of $15 \pm 10$ will be sufficient to conduct the interview, according to the available time and resources. In this article, the researcher reached information saturation after conducting ten interviews. Carrying out this step will lead the researcher to describe countless aspects of the phenomenon. The results of the first and second phases constitute the discourse space. In the third phase, it should be organized by evaluating and summarizing the contents of the discourse space and selecting a sample of statements as a Q sample among them. McKeown and Thomas suggested a number of 30 to 100 statements for the Q sample, but usually between 50 and 70 statements are selected. Donner believes that the appropriate number of statements for the findings to be statistically valid is between 20 and 60 statements. In the fourth phase, the participants will sort and categorize the Q deck. This phase is actually the stage of data collection. In the last phase, the collected data will be analyzed using the Q-factor analysis method, and the extracted factors will be interpreted. It should be noted that in quantitative studies, there is a community where the results of the study are used at that level, and it has a sample that is selected randomly and is generally a representative sample of that society. The Q method lacks such a community and sample, and usually the researcher selects a sample of people from among those who either have a special relationship with the research topic or have special beliefs. On the other hand, the Q study does not provide information about the "distribution" of the variables in order to discuss their generalizability; rather, it talks about the "existence" of different subjectivities. While the whole sample is important in conventional quantitative studies, in the Q study, the collocation of each individual is considered to be quite important and a significant type of information. Therefore, unlike the usual quantitative methods in which a small number of questions are asked from a large number of respondents, in the Q study, a large number of questions are asked from a small number of respondents. In fact, quantitative studies emphasize distributions more than anything else, but Q studies emphasize questions. Therefore, the concept of generalizability in the Q study is quite different, because it only seeks to discover different mental models, and in order to discover a model, the existence of only one person with that specific model is sufficient.

## 3 VALIDITY AND RELIABILITY OF RESEARCH

Regarding the validity of the Q method, it can be said that the validity check is considered when a construct (a latent characteristic) is measured, because in such a case, the researcher is faced with the question of whether the constructed scale really measures the same thing it is intended to measure. This is despite the fact that the study of Q does not seek to measure any construction. What can be said about Q's study is the comprehensiveness of Q's sample statements. In other words, the researcher should ask himself whether the collected statements have such comprehensiveness and scope that they can show different subjectivities. Hence, the validity of the content can be evaluated based on the rating given by the participants to the statements and their adjacent statements. Also, formal validity is possible by examining the level of satisfaction of the participants regarding the capacity and capability of statements to show their mentality; i.e., whether the existing statements have addressed the various aspects of the subject under investigation so that they can express their mentality through sorting. For Q sorting,

reliability can also be considered. That is, it can be asked whether a participant sorts a deck of cards with the same instructions in different iterations in the same way. It should be noted that depending on the subject of the Q study, the spectral grades, and the number of cards, it can be expected that the repetition of the sorting will not lead to a completely identical result.

## 4 RESEARCH FINDINGS

By reviewing cognitive biases in behavioral economics, active statements in the field of economic behavior of managers of research and technology funds will be discussed.

At this stage, it has been tried to study written and unwritten opinions about behavioral economics and related mental models, macro-decisions, the comments of 13 CEOs of research and technology funds, and a review of the research literature among the 30 propositions obtained from the background and available sources, and finally 17 statements are confirmed, which are shown in the "Tables 1 to 3". For categorization, a Q-plot was set up for 17 Q-set statements in such a way that the managers could sort the sets of statements in a normal distribution and according to the standard method, from so much agree (+4) to disagree so much.

**Table 1** Cognitive biases in behavioral economics

| | | |
|---|---|---|
| Access | People estimate the probability of an event based on its ease of recall. | traders place more emphasis on their recent trades and allow recent results to interfere with their trading decisions |
| Dilution effect | Irrelevant data undermines other relevant data | Using more trading tools and concepts for price analysis can weaken the importance of decision drivers |
| The sophistry of gamblers | People believe that probabilities should cover each other in short term. | Traders have misinterpreted the randomness of phenomena and believe that after three losing trades, the probability of a winning trade is higher, while the probability of the occurrence of phenomena does not change based on past results. |
| Anchoring | Paying too much attention to the first available piece of information. | When it comes to entering a trade, people base their entire charting and analysis on the entry price, and don't pay enough attention to the overall image of the market. |
| Confirmation-Affirmation | i.e., look for information that confirms your beliefs, ideas and actions. | The trader disregards the reasons and signals that disapprove his trade and only looks for confirmations. |
| Overconfidence | People have higher self-confidence in doing things, contrary to their skill level. | Traders misjudge their level of experience and skill; and those who lose all the time, do not consider it their fault. |
| Selective Perception | Forgetting the things that cause discomfort | Traders easily forget their mistakes and wrong trading decisions that cause them to lose heavily. |
| Profiteering | We consider ourselves responsible for our profits and do not bear the responsibility for our losses. | Traders blame the market or unfair conditions when they make losses, but accept full responsibility for their wins. |
| Insensitivity to sample size | Understanding the difference between large and small sample sizes. | Traders often make their assumptions about the accuracy of their trading system based on a few limited trades or change their trading parameters after a few losing trades. |
| Epidemic Mentality (Communicable) | Avoid contact with people who have been infected in previous contact. | Traders no longer go to markets and financial instruments in which they have experienced a heavy failure, even if the failure was due to the trader's own error. |
| Perception | We consider events happening right now to be more likely to have occurred in the past. | People by looking at past trades and investigating the cause of their failure, come to some conclusions that they did not have at the time. |
| Hot hand sophistry | After success in one random event, another success is also highly likely. | Traders believe that when they are on a winning streak (consecutive wins), it |

| | | |
|---|---|---|
| | | becomes easier to trade, and they can sense where the market is going. |
| Peak-End Rule | People judge an event based on how they feel at the peak of that event. | Traders look at losing trades and only see how much profit they gained, but they do not take into account the problem that followed. In fact, traders in losses are more likely to regret why they did not take the profits of the price movement than to regret why they lost so much, and they see the loss in not making money rather than in not losing. |
| Simulation Subjectivity | People regret more when they miss an event by a small amount. | A price where you missed profit by a small margin, or a trade where you stop because of a few pips, is more painful than other trading failures. |
| Social Reason | When people are not sure what to do, they look at what other people are doing. | Traders are more likely to seek advice from other traders when they are unsure of what to do, even if their trading strategy is completely different from theirs. |
| Framing | People make decisions based on how things appear. A profit is much more valuable than a loss, and a certain profit is much more valuable than a probabilistic larger profit. | Traders make trades in profit too early because the value of the current profit is greater than the value of a larger profit to them in the future. |
| Drowning | We invest in one thing just because we have invested in it before. | Add to a losing trade, because you invested in it, even if there is no reason to do so. |

**Table 2** CEOs opinions about behavioral economics

| Statements No. | Statements | Factor scores of the 1'st mental model | Factor scores of the 2'nd mental model | Factor scores of the 3'rd mental model |
|---|---|---|---|---|
| Q1 | The impact of the directives of the Vice Presidency for Science and the Innovation and Prosperity Fund is clearly evident in the performance of the funds. | 22 | 40 | 36 |
| Q2 | Regarding the allocation of credits and facilities to knowledge-based companies, they will perform their analysis based on financial statements and profit and loss statements, and will not pay attention to the overall image of the market for that product in micro-facilities. | 33 | 7 | 4 |
| Q3 | The bad record of the knowledge-based company has a great impact on not granting facilities to that company. | 50 | 15 | 23 |
| Q4 | Failure to repay the facilities on the due date is directly related to the practical experience and reports of the assessors of these funds. | 40 | 13 | 18 |
| Q5 | The ability of the knowledge base company to repay the loan is more important than the amount of the granted facility. | 40 | 25 | 9 |
| Q6 | The current economic conditions of the country are the main reason for the reluctance of funds to participate in venture capital. | 36 | 30 | 21 |
| Q7 | Short-term profitability from granting facilities for managers and appraisers is more attractive than higher profit with more risk. | 28 | 19 | 4 |
| Q8 | Internal resolutions of research and technology funds are more enforceable than upstream resolutions. | 19 | 5 | 12 |
| Q9 | The procedures established in different funds have a direct effect on the performance of other funds. | 8 | 6 | 19 |

| | | | | |
|---|---|---|---|---|
| Q10 | Referring high-yield and low risk projects, prevents managers from paying attention to lower-yielding business projects. | 4 | 19 | 4 |
| Q11 | The effective contribution of communication in the plans sent to the funds is more than their skills and expertise. | 39 | 15 | 30 |
| Q12 | Funds, as the influential leverage in the system of innovation and value creation, are directly involved in increasing the contribution of domestic production. | 25 | 15 | 22 |
| Q13 | Funds, as venture capital project contributors, carry out large-scale transactions due to their high level of information. | 11 | 29 | 38 |
| Q14 | Without a feasibility study and proper presentation plans of firms, it is not possible to invest in the plan. | 39 | 20 | 37 |
| Q15 | In participating in venture capital projects, funds do not exceed a certain price range and prefer to diversify their risk portfolio. | 20 | 35 | 27 |
| Q16 | Fund management board members tend to continue many low-yielding plans (as a result of wrong decisions) until reaching the break-even point. | 27 | 8 | 10 |
| Q17 | Failure to timely reimbursement of firms' loans will cause the funds to not approve their loan requests in the future. | 40 | 22 | 15 |

**Table 3** Q-plot

| Absolutely agree | | | | | Absolutely disagree | | | |
|---|---|---|---|---|---|---|---|---|
| -4 | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 |
| | | | | | | | | |
| | | | | | | | | |
| (2) | | | | | | | | (2) |

## 5 CATEGORIZATION AND CONCLUSION

1- What is the mental model of the managers of research and technology funds in Iran? What is the categorization of these factors based on Q methodology? In other words, what mental models exist among the participants regarding the research topic?

Mental model 1: The first mental model includes the category of managers who, due to the non-specialist nature of the fund, the high initial capital, and the composition of the fund's board of directors, focus on the internal regulations and are less inclined to take risks in accepting investment plans and giving facilities. They pay a lot of attention to the experience of the fund's assessors and experts and consider the responsibility of their mistakes to be excessive. They spend a lot of time reviewing the plans and finally, with the intuitive view of the board members to reduce the risk of the plans, they refuse to participate.

Mental model 2: In the second mental model, there are managers who are interested in attracting new projects to participate in investment according to the specialized nature of their fund. These managers believe that all plans should be reviewed and their portfolios should be more diversified through a feasibility study. They share in the risk of investments through their connections and by relying on their information knowledge about the specialized field (for instance, the electricity and energy fund). In granting all kinds of facilities, according to the credit line available in the Innovation and Prosperity Fund, they accept projects without prioritization and in order to accelerate earnings. According to these managers, the goal of earning profits and a better performance record of the fund is more important than the mission of establishing research and technology funds (the growth of domestic production and the increase of turnover in the country).

Mental model 2: These managers have a systematic view of the current situation and prepare explanatory plans according to market analysis in various fields and using the knowledge of experts. They try to reduce errors by organizing seminars and sharing and conveying experiences, and they do not limit themselves to their information. In the meetings of the board of directors, they persuade the shareholders and members of the board of directors, citing the information collected. This group have success in attracting high-return projects through their connections. The long-term view of these managers has caused them to experience higher profitability in the long term in participating in high-risk investments.

2- What behavioral errors occur in these mental models according to behavioral economics approaches?

In the first mental model, investors claim to have confidential information about the company and refuse to diversify it. People tend to have a lot of confidence in the correctness and accuracy of their judgments; and in an experiment on the General Information Test that was conducted, the dominant answer of them was that they were 100% sure, while they had actually answered 70 or 80% of the questions.

In the first mental model, managers and their investors have a representative cognitive bias. Essentially, humans tend to imagine chances and possibilities in a way that is consistent with their previous ideas and perceptions, even when the resulting inference is statistically invalid. For example, the "gambler's illusion" refers to the common misconception that success and luck in betting and gambling occur periodically. Similarly, fund managers tend to determine the success of an investment, for example, in Company A, by placing it in a familiar and understandable classification table. The description of this feature in brief is that investors often behave in a stereotypical manner when making investment decisions.

Another behavioral bias observed in the first mental model is when managers feel that they are skilled or knowledgeable, and prefer to bet on ambiguous phenomena that they believe can predict their consequences and outcomes based on their own judgment and evaluation, rather than betting on random events of equal probability. By contrast, when they don't feel proficiency or awareness in themselves, they prefer to bet on chance events. This is called the "resourcefulness" effect (or "know-how" effect), which is itself an aspect of ambiguity aversion and has a lot to do with fund managers.

Ambiguity aversion can lead investors to believe that the stocks of the companies they work for are safer and less risky compared to the stocks of other companies. The managers of subsidiaries of the holdings of research and technology funds are more reliable.

It should be noted that when investors are exposed to the resourcefulness effect, it is very important to advise them about potential mistakes such as repeated trades that are detrimental to one's assets. The resourcefulness effect is also involved in the formation of indigenous dependence bias or the tendency to keep assets close to oneself. Graham, Harvey, and Hong showed that the investors who are more willing to convert a portion of their assets into foreign securities are those who feel that they have the most resourcefulness in investing in foreign assets. The basic advice is not to let resourcefulness in a particular field prevent you from investing in other fields.

Another behavioral bias in the first mental model is the confirmation of fund managers and board members. This bias, called confirmation bias, refers to our ability to convince ourselves to believe whatever we like. We are overly focused on the events that consolidate and reinforce our desired outcomes, undervaluing what conflicts with them. Confirmation bias can be seen as a form of selective bias in gathering evidence and documents in order to determine certain beliefs, through which the decision-maker either overvalues information that confirms their claims or actively seeks out, while ignoring or underestimating evidence that may refute their claims.

In order to prevent this behavioral bias, it is suggested that managers avoid focusing too much on the stocks of their subsidiaries, and focus more against negative news and information about their companies. It is also essential to research on competing companies.

Behavioral bias in the second mental model based on anchoring and adjustment, is a psychological process that affects the way people evaluate probabilities. Managers who are exposed to this bias, often act under the influence of upstream rules based on individual preferences. Reasonable managers deal with new information realistically and do not involve predetermined issues such as the product market and the company's performance in their decisions. However, the anchoring and adjustment bias causes managers to focus on psychological anchor points (tendencies, preferences, and the regulations of the Innovation and Prosperity Fund and the Scientific Vice President) rather than on statistics. In this way, financial decision-making deviates from the prescribed norms of the "neoclassical school", i.e. "reasonableness".

There is also an overconfidence bias in the second mental model. Overconfident fund managers hold non-diversified portfolios. They do not exceed a certain range of risk and invest in industrial and non-industrial projects within a certain range.

The behavioral bias of the third model can be called hindsight bias. The managers with high risk-taking tendency have the false belief that they have predicted the outcome of an event from the very beginning. This bias affects future predictions. Managers subject to the event bias think that the outcome they see at the end is actually the only outcome that has always been possible. Therefore, they underestimate the uncertainty that exists before the event and underrate the consequences that could have be realized but did not happen. Also, relying too much on the data of evaluators and experts and the high volume of information causes the dilution effect in such a way that irrelevant data overshadows important data and prevents the prioritization of projects.

## 6 CONCLUSIONS

In this research at first, behavioral economics literature was reviewed. In the second phase, 13 managers of research and technology funds in Tehran and other provinces were interviewed. After detailed

investigations and data organization, about 30 statements or phrases were identified; Finally, 17 statements were selected as Q sample. It is worth noting that those statements that were more frequent, or which the interviewees seemed to view at them from different sides or had different points of view, were selected as Q samples. In the next step, to form the Q category, 17 Q cards were designed in such a way that a Q sample statement (phrase) was written on each card. After reading the cards, the participants sorted them according to the given Q chart. The results imply the existence of cognitive and behavioral biases in representativeness, resourcefulness, and confirmation, in the first mental model, and the anchoring and adjustment bias as well as the overconfidence bias in the second mental model. In the third mental model, according to the findings obtained from managers, there are hindsight and data dilution biases. Finally, by providing nudges (suggestions) in the discussion section, an attempt has been made to reduce these biases, and managers can be more efficient and effective in their decisions by being aware of these behavioral biases.

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