


Research article

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The Impact of the Framing Effect on Potential Investor Decision-Making: Results of an Oculographic Experiment

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Abstract

Introduction. In recent years, private investors have significantly increased their influence on the Russian securities market. Understanding the cognitive biases of private investors will help to fill the gap in research into cognitive decision biases in decision-making in investment behavior. Private investors participate in the placement of federal loan bonds and also support private enterprises through participation in corporate bonds. This study aims to test experimentally the impact of the framing effect (the effect of the 'frame' or information presentation format) on the decision-making of potential investors in securities trading. **Methods.** The sample comprised 20 adults aged 20–35 years (7 men and 13 women). Stimulus materials were presented on the Neurobureau platform for neurocognitive research and involved recording subjects' videooculography using the GazePoint GP3 eye tracker (with the Neurobureau software). A total of 240 measurements were carried out. The experimental series consisted of 12 stimuli. Pairs of financial proposals were created, with differences provided only by different formulations and emotional and semantic features. **Results.** Using quantitative data analysis, significant differences were established between responses to stimuli of the same content but different wording. A step-by-step regression analysis confirmed the impact of the framing effect on economic decision-making. In qualitative data analysis, the proportion of attention to stimuli was determined using heat maps, which also confirmed the role of lexical forms and emotional connotations of the wording of company news (without changing objective information) in purchasing and selling shares or in not taking action.

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Discussion. The results of the experiment proved the impact of the framing effect on the decision-making of potential investors. Based on the obtained data, a conclusion is drawn on the importance of psychological factors in selecting and assessing information resources in the process of obtaining company news information.

Keywords

decision-making, stock exchange, framing effect, eye tracking, oculography, potential investors

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Introduction

The framing effect is a cognitive bias when the form of information representation affects the subject's perception (Kahneman & Tversky, 1984). This concept is generally considered in the context of dual-process theories of thinking. According to these theories, human thinking includes cognitive processes and strategies that are intuitive (System 1) and analytical (System 2). Most human behavior is believed to be controlled by System 1. It makes it possible to react quickly to situations with minimal attention and time resources (Kahneman, 2003).

Due to a lack of time, the quality of decisions may deteriorate (Maule & Edland, 2002), and the decision-making strategies may change (Ariely & Zakay, 2001). This is explained by the characteristics of System 1. Its speed compensates for inaccuracies and vulnerability to various types of cognitive biases (Evans & Stanovich, 2013). Such biases include the break-even effect (Thaler & Johnson 1990), representative heuristics (Nazlan, Tanford & Montgomery, 2018), and the framing effect.

Most research on the influence of the framing effect focuses on areas where decisions must be made quickly and often without full information, such as medicine (McNeil, Pauker, Sox & Tversky, 1982) and consumer psychology (Sanford, Fay, Stewart & Moxey, 2002; Sun, Hu & Yu, 2022). In these situations, behavior is controlled by System 1, which leads to biases, including framing effects. Private investors often need to make quick decisions to buy or sell securities. The abundance of cognitive biases generated by the speed of decision-making prevents investors from properly understanding the situation and assessing risks (Pompian, 2006). Studies in this area confirm that time constraints can change investors' perception of risks (Huber & Kunz, 2007), including

in terms of the framing effect (Young, Goodie, Hall & Wu, 2012). Other studies show the influence of information presentation. Thus, respondents made different decisions when selecting funds to invest, depending on how the returns were presented (absolute figures or percentages) (Diacon & Hasseldine, 2007). The decision-making of private investors is strongly influenced by the media covering the company's activities (Barber & Odean, 2013; Fedorova, Demin, Afanas'ev, & Rogov, 2020). Analysis of annual reports from more than 300 companies from different countries revealed the selective use of charts and their distortions depending on company-related performance indicators in the past year (Beattie & Jones, 2000). Accordingly, given the tendency of individual market players to manipulate, private investors must be able to accurately assess information (In'kova, Adasova, 2021; Kong, Shi & Zhang, 2021).

With the increase in the number of private investors in recent years, it is necessary to study their behavior. In 2020, more than five million individuals entered the market, and in previous years – about 3.8 million individuals (according to the analysis summary on the Moscow Exchange website, URL: <https://www.moex.com/n32140/?nt=106>). Such an active increase in the number of investors was largely due to the influence of the Central Bank of the Russian Federation and the state (increasing interest rates and tax benefits through a special brokerage account – IIS), and the active pressure exerted by the Russian largest banks to use brokerage services (Abramov, Radygin, & Chernova, 2020).

In 2022, the number of private investors reached almost 23 million. In addition, the number of daily transactions carried out by individuals increased from 392 thousand in December 2019 to an average of more than 2.2 million transactions by 2022 (MB, <https://www.moex.com/n53950/?nt=106>). In 2022, non-residents were denied access to the Russian stock market, and private investors also increased the influence on the stock market significantly – shares increased by 45.3 %, bonds increased by 87 %, forward markets increased by 40.7 %, spot currencies increased by 65 % (MB's analysis summary <https://www.moex.com/n54937/?nt=106>).

According to Saibel' and Koval'chuk (2018), the Russian market has always been considered to be very volatile due to changes in the exchange rates of Russian national currencies and changes in world prices of main raw materials – oil, gas, and metals. However, changes in the ratio of private investors and non-residents affect market volatility due to the sensitivity of the first to cognitive biases and investment characteristics (low investment horizon, excessive emotionality in response to stock market changes) (Schroders International Investor Research, https://prod.schroders.com/en/sysglobalassets/_global-shared-blocks/gis-2019/theme-1/new-full-report/global_investor_study_2019_t1_v7_v4_eng.pdf).

Due to the increased influence of physical investors on the market, research on the cognitive biases of investors is important. The development of information and communication technologies also changes the approach of private investors to trading (Barber & Odean, 2002). However, this issue remains largely undeveloped in Russia, despite

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the active growth of private investors and the influence they have on the development of the country's economy through the issue of federal loan bonds and when the issuers are individual regions of the country. It is also important for private investors to participate in the placement of corporate bonds to support the development and existence of national companies in difficult economic times.

This study **aims** to experimentally examine the impact of the framing effect (the effect of the 'frame' or the form of information presentation) on potential investors' economic decision-making.

To study the impact of the framing effect on the cognitive behavior of potential investors, the eye-tracking methods are recommended, as they are used in social and human sciences to identify visual attention and decision-making processes (Skuratova, Shelepin, & Shelepin, 2022).

Research hypotheses are as follows: (1) In the process of visual perception of paired visual stimuli with different information presentations, the oculomotor activity of the study participants will vary in the number and duration of fixations. (2) The framing effect will influence economic decision-making.

Methods

The data were collected with a GazePoint GP3 computer oculograph (60 Hz sampling rate) and Neurobureau software created by Neuroiconics to record oculomotor activity in the economic decision-making process. The eye tracking data were compared with the responses of the participants.

The criteria for selecting subjects included the absence of specialized economic education in stock market trading, the absence of experience in stock market trading, the absence of a history of neurological or psychiatric diseases and the absence of medication intake that could affect the results of the experiment.

The study involved 7 men and 13 women aged 20 to 35 years ($n = 20$, mean age 23.5 ± 4.01 years). As the study procedures included recording participants' eye movements using eye tracking, all subjects had normal or corrected-to-normal vision. Participation in the experiment was voluntary; participants could refuse to participate at any time without explanation. The duration of the experiment was 7 to 11 minutes, depending on the speed of the participants' responses.

Stimulus materials

To achieve the main goal of the study, visual stimuli must be created with different lexical forms and emotional meanings of the news formulation without distorting the information component. It was also necessary to create a feeling of belonging to the company to properly assess the risks to which real investors are exposed. The stimulus materials consisted of 12 news from different companies and were combined into six pairs.

1. The capitalization of Company A (total value of the company) decreased by up to 25 % during the pandemic.
2. The capitalization of Company A (total value of the company) decreased by only 25 % during the pandemic.

Stimulus materials can be found in Appendix 1.

Research procedure

The participant was placed in front of the computer at a fixed distance of 50 cm. Before the data collection began, the subject was calibrated to fix the eye tracker in the pupils. The instructions were presented on a white screen in a black font and contained detailed information on tasks and answers. If the subject had questions, the experimenter gave verbal explanations. In order to maintain the internal validity of the experiment, participants were not informed of the purpose, objectives, and hypotheses of the experiment. After reading the instructions, the subjects underwent a training session that included a slide similar to the experimental session but not taken into account in the responses and analyses. For each subject, visual stimuli were presented in a randomized order. At the top of the slide there was information that created a sense of belonging to the company, "Imagine that you invested 30 % of your monthly income in this company". The news was presented in the center of the slide. At the bottom of the slide, information about answer options was provided. The participants' answers were recorded by pressing the appropriate keys on the computer keyboard.

Processing the results

The results of the study were qualitatively and quantitatively analyzed. The qualitative analysis process used heat maps to determine the percentage of attention to stimulus elements. To determine the impact of the framing effect on the choice of three alternatives, the statistical significance of the differences in the first and second stimuli for each pair of investment proposals was examined. Furthermore, step-by-step regression analysis was used to identify the impact of a particular phrase that constitutes the framing effect on decision-making.

Results

The assessment of the significance of differences in the perception of different wording used for investment proposals (stimulus pairs) showed that the Chi-square value exceeds the critical value ($14.29 > 9.21$; at $p = 0.01$), the number of degrees of freedom ($df = 2$). Thus, the differences in decision-making were statistically significant ($p < 0.01$).

However, these results do not enable us to conclude that the word or phrase has a direct impact on the subjects' decisions. To demonstrate the importance of different

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wording used for investment proposals, a step-by-step regression analysis of the subjects' responses to purchase/sell and eye tracking variables were used within the following areas of interest:

- The number of returns to the area of interest (hereinafter 'returns'), i.e., the number of times the respondent returned to the area of interest.
- The total number of saccades to the area of interest (hereinafter 'saccades'), i.e., the number of saccades the respondent made to the area of interest while viewing the stimulus. Only the saccades which beginning and end were located within the area of interest were considered.
- The average period of fixation on the area of interest (hereinafter 'fixations'), i.e., the average time period of fixation on the area of interest (duration of all fixations on the area of interest/number of fixations) (Shelepin, Shelepin, Skuratova, Zueva, 2020).

On the slides with stimulus materials, three areas of interest were identified – the entire slide, the news itself, and the changed wording in a pair of stimulus words. The step-by-step regression analysis consists of several steps.

In the first stage, the influence of the variables (predictors) mentioned above on the subjects' responses to the first stimulus of the corresponding pair was assessed. The relationship (R) between the subjects' responses and the variables in the first stimulus was 0.208. At the same time, 4.3 % of the variance in the results of the subjects were explained by the effects of predictors (R-square = 0.043). Since no significant correlations were found, variables did not affect the results of the subjects: 'returns' (p = 0.592), 'fixations' (p = 0.132), and 'saccades' (p = 0.165) (Table 1).

Table 1

The impact of variables on decision-making when presenting the first stimulus of the corresponding pair

The first stimulus of the pair				
	B	Standard error	β	Significance
Returns	0.094	0.174	0.052	0.592
Fixations	1.465	1.013	0.132	0.151
Saccades	0.447	0.32	0.135	0.165

Note: B – regression coefficient; β – standardized regression coefficient; The standard error is an indicator of the stability of the coefficient B.

In the second stage, the influence of the variables (predictors) mentioned above on the subjects' responses to the second stimulus of the corresponding pair was also assessed. The relationship (R) between the subjects' responses and the variables in the second stimulus was 0.375. At the same time, 13.9 % of the variance in the results of the

subjects were explained by the effects of predictors (R-square = 0.139). In this case, some of the variables had a statistically significant effect on the subjects' responses: 'returns' ($p = 0.01$), 'fixations' ($p = 0.047$), and 'saccades' ($p = 0.309$) (Table 2).

Table 2

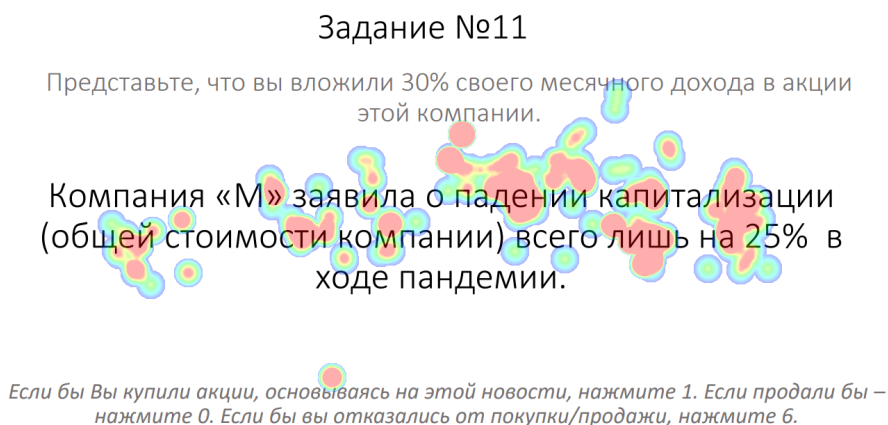
The impact of variables on decision-making when presenting the second stimulus of the corresponding pair

The second stimulus of the pair	B	Standard error	β	Significance
Returns	0.586	0.417	0.294	0.001
Fixations	2.678	0.174	0.176	0.047
Saccades	0.36	0.352	0.09	0.309

Figure 1 shows a heat map generated from the analysis of data from all subjects.

Figure 1

Heat map form the data from all subjects



The heat map shows the distribution of visual attention represented using a color gradient, with red representing the most important areas. This image shows that the area of interest (changed wording) – 'only' – is one of the main areas of attention fixation.

Discussion

Therefore, the results obtained using Chi-squares showed statistically significant differences between the responses to each pair to stimuli (14.29, $df = 2$; $p = 0.01$). This enabled us to make the conclusion that the respondents made different decisions. It was not yet clear whether this change was influenced by wording or by other unaccounted for variables. To determine the influence of the form of information presentation on changes in responses, a step-by-step regression analysis was performed.

Regression analysis found that the variable of 'saccades' did not have statistically significant relationships to assess its influence on the responses ($p = 0.309$). The variable of 'fixations' has a statistically significant effect on decision-making, but the level of significance is at the threshold level ($p = 0.047$) and should be examined again in a larger sample. The variable of 'returns' had a statistically significant effect on investment decisions ($p = 0.01$).

Thus, the return to a changed wording was the best predictor of the subject's decision among the variables selected for analysis. As a result, when the same information is presented in different forms, the subject's decision is significantly changed, and this effect depends directly on wording changes (see Figure 1). Thus, the data obtained confirm the previously stated hypothesis that (1) in the process of visual perception of paired visual stimuli with different information presentations, the oculomotor activity of study participants will vary in the number and duration of fixations and (2) the framing effect will influence economic decision-making.

The results obtained are consistent with the results of other researchers, such as the introduction of a recommendation in the process of independent economic decision-making has a significant impact on the willingness to put resources at risk (Folomeeva, Vinokurov, Fedotova, & Sadovskaya, 2022), and with other studies using eye tracking in areas of economic choice. Thus, researchers have found that the individual characteristics of subjects, such as the level of emotional enthusiasm and detachment, can influence decision-making (Toma, Cepoi, Kubinschi, & Miyakoshi, 2023). Furthermore, it has been shown that the characteristics of information presentation influence its perception and the decision-making process. Thus, the impact of the latest information received (Duclos, 2015), the impact of information modality (Fulmer, 2014), and the impact of visual emphasis on information (Sirois, Bédard, & Bera, 2018) have been identified. Our experiment demonstrates the impact of information presentation formats, which is consistent with the study of Hess et al., that revealed the impact of graphic presentation of information on risk perception (Hess et al., 2010).

Another similar eye-tracking study compared positive and negative framing and found differences in respondents' processing effort depending on the type of framing (Kuo, Hsu, & Day, 2009). A study conducted on lay investors found similar results – the format of information presentation (strategic or shareholder-oriented) influences investors' attitudes and stock buying/selling decisions (Cheng, Ko, & Green, 2023).

The data obtained are important for understanding the cognitive biases of private investors in trading on the stock exchange, as they are an important part of the Russian economy. The results are also important for investors themselves because they show the need to acquire information on the website of the company, not information intermediaries, because financial and non-financial reporting is strictly regulated by Russian legislation.

Conclusion

In our study, the responses of the subjects changed depending on different wording used for the news information. Evidence has been obtained that the lexical forms and the emotional connotation of news phrases (without changing objective information) influence the decision to purchase or sell shares in a company. This was reflected in the parameters of the oculomotor activity of the study participants in the process of visual perception of paired visual stimuli with different information presentations (parameters of the number and duration of fixations). Therefore, the results obtained enabled us to conclude that the framing effect has an impact on investment decision-making.

Research limitations

The disadvantage of this study is a relatively small sample size ($n = 20$). This limitation is expected to be overcome in the next study.

Another important limitation of this study is the lack of a clear operationalization of the concept of the framing effect in the experiment. Meanwhile, researchers (Levin, Schneider, & Gaeth, 1988) distinguish three types of framing:

1. Risky choice framing (two options are framed either positively or negatively, but with different degrees of risk).
2. Goal framing (two options lead to the same goal, but in one case through negative consequences if not achieved, and in another through positive consequences if achieved).
3. Attribute framing (two options to describe the same attribute – a positive and a negative description).

Thus, future research needs to more precisely operationalize the phenomenon under study on the basis of existing theoretical concepts.

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Appendix 1

Stimulus materials

Task 1.

Insiders predict that there is an 80 % chance that Company C will prepare a good report to ensure long-term growth of shareholder value.

Task 2.

This year, Company Q reported a record decline in capitalization rates (the company's total value). Most experts agree that the reason is external factors.

Task 3.

An anonymous source from Company F predicts a 80 % probability of a drop in the company's revenues.

Task 4.

This year, Company W reported an expected decline in capitalization rates (the company's total value). Most experts agree that the reason is external factors.

Task 5.

Company K reported high profits last year. It amounted to 500 billion rubles.

Task 6.

Company M reported a decline in capitalization rates (the company's total value) by only 25 % during the pandemic.

Task 7.

According to the results of the financial performance of company J, the Board of Directors voted to change the General Director.

Task 8.

At the extraordinary general meeting of shareholders of Company I, the Board of Directors voted to change the General Director.

Task 9.

An anonymous source from Company E predicts a 80 % probability of a decline in the company's revenues.

Task 10.

Insiders predict that there is a 20 % probability that Company D will produce a bad report, which will result in a long-term decline in shares.

Task 11.

Company B reported a decline in capitalization rates (the company's total value) by as much as 25 % during the pandemic.

Task 12.

Company L reported its standard profit last year. It amounted to 500 billion rubles.

Stimulus pairs: 1–10, 2–4, 3–9, 5–12, 6–11, 7–8.

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Author Contribution

Leont'ev Arsenii Vladimirovich contributed to the experimental design and the choice of statistical methods, processed the data, interpreted statistical data, wrote the Introduction and the Discussion sections.

Letyagin Pavel Igorevich contributed to the choice of research methods, collected the data, wrote the Methods and the Results sections.

Deyneka Ol'ga Sergeevna supervised the research, prepared the instructions for the stimulus materials, edited the text of the manuscript (logic, style).

Tkacheva Lyubov' Olegovna contributed to a critical revision of a part of the content of the manuscript and to scientific and literary editing.

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Conflicts of Interest Information

The authors have no conflicts of interest to declare.