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RESEARCH ARTICLE

Evaluation and Classification of Behavioral Biases According to Thinking Styles, Risky Investment Intention, and Subjective Financial Literacy

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Abstract
The main purpose of this study is to classify the 20 biases into different groups (factors) and estimate each of them according to the variables of rational, experiential-affective, risky investment intention, and financial literacy. Behavioral finance, which combines the concepts and approaches of psychology with the theory of finance, evaluates individuals' deviations from rational choices in their financial decisions with the concept of biases. In this context, the data were collected from 1188 subjects in Turkey through online surveys using a convenience sampling method between 14 May - 28 June 2020. Participants were gender-balanced, young, single, and highly educated. An exploratory factor analysis, ANOVA, an independent sample T-test, and a correlation analysis were performed using SPSS. In addition, a confirmatory factor analysis was performed using structural equation modeling. According to the results, these 20 biases were grouped into four groups according to the variables of thinking style, risky investment intention, and subjective financial literacy level. It was determined how both these four groups and individual biases differ according to thinking styles, risky investment intention and their levels of subjective financial literacy. In addition, it was also investigated whether both bias groups and other variables differed according to four demographic variables.

Keywords

Behavioral Biases, Thinking Styles, Risky Investment Intention, Subjective Financial Literacy

Introduction

People make decisions in their daily lives. Some of these are based on preferences that do not require knowledge and awareness, such as what to eat for lunch or to drink tea or coffee, and whose accuracy and wrongness are not questioned much. In addition to these, sometimes it is in selections that require information and may be correct or incorrect, such as whether to accept a job offer which has a high salary in a different city or to choose between one of two positions offered in the same workplace. People tend to seek information about such

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decision problems (Baker, 2019). Nowadays, the problem is not the scarcity of information but its abundance. There are also information-searching distractions that we call noise. In such a decision making problem, when people are exposed to too much information or noise, they filter most of them and choose what they believe to be the most useful (Peon, Antelo, & Calvo-Siilvaso, 2017; Baker, 2019). However, from where that information is obtained and how it is analyzed is an important issue. At this point, individuals try to simplify information processing by using mental shortcuts called heuristics (Peon et al., 2017; Baker, 2019) in order to find a satisfactory solution instead of an optimal solution (Simon, 1972).

The difference between what should be done and what has been done regarding that information, and where to get it and how to use it points to behavioral biases. Behavioral biases affect investors and experts' judgments (Baker & Ricciardi, 2014). Bias is defined as a tendency to make mistakes and, heuristics as a rule of thumb (Shefrin, 2008; Baker & Ricciardi, 2014). Since individuals' preferences are influenced by their beliefs (Baker & Ricciardi, 2014), they exhibit many biases (Chira, Adams, & Thornton, 2008; Baker, 2019). However, it is not very easy to identify them (Goetzmann & Massa, 2008), and these biases cause errors in decision-making processes (Shefrin, 2008; Baker & Ricciardi, 2014; Blumenthal-Barby, 2016; Peon et al., 2017; Baker, 2019). Both psychology and behavioral finance studies state that people think using shortcuts and make decisions under the influence of various biases (Peon et al., 2017). Studies show that there are individual differences under heuristics and biases (Ceschia, Constantinia, & Sartoria, 2019).

Peon et al. (2017) refer to two different views on heuristics. According to the first, it is effective short-cuts developed through basic psychological mechanisms. In the second view, according to the dual-process theory, heuristics are the second of the two existing cognitive systems (reason and intuition). The intuitive system is an affect-driven and effortless cognitive system. Tversky & Kahneman (1974) also evaluated intuitions as mental shortcuts, biases, and heuristics. Heuristics are formed by affect evaluation, are automatic and accessible, and are highly functional in evaluations such as good-bad, positive-negative (Peon et al., 2017). Affect provides faster intuition than recall from memory (Peon et al., 2017). Loewenstein, Weber, Hsee, & Welch (2001)'s risk model also refers to the effect of affect. Investors make decisions based on past events, beliefs and preferences (Baker & Ricciardi, 2014). Loewenstein et al. (2001)'s risk model also refers to the effect of affect. Investors make decisions based on past events, beliefs and preferences (Baker & Ricciardi, 2014). For this reason, investment decisions have both qualitative and quantitative features.

The uncertainty inherent in an investment requires an intuitive solution (Pretz & Totz, 2007). Intuitive people use stereotypes instead of concrete facts to predict probabilities. As Kahneman (2013) states in his book "Thinking, Fast and Slow", there are two thinking styles according to dual-process theory, analytic and intuitive. Analytic thinking is slow and rule-

based. However, the intuitive thinking style is fast and automatic. The intuitive style is associated with emotions and refers to its three properties: the affective, heuristic, and holistic (Pretz & Totz, 2007). An experiential/intuitive style is also based on emotions and affect (Pretz & Totz, 2007). Affect is not intuitive but related to it (Pretz & Totz, 2007). Similarly, Thaller & Sunstein (2008) mentioned two different thinking styles and labeled them automatic and reflective systems. The automatic system is fast and feels instinctive, and is not usually associated with word thinking. The reflective system, on the other hand, is expressed as understanding situations by thinking and logic (rational). The differences between these systems are listed in Table 1.

Table 1
Thinking Styles

Automatic (Intuitive) System	**Reflective (Analytic) System**
1. Uncontrolled	1. Controlled
2. Effortless	2. Effortful
3. Associative	3. Deductive
4. Fast	4. Slow
5. Unconscious	5. Self-aware
6. Skilled	6. Rule-following

Pretz & Totz (2007) state that individuals' thinking styles are a personality structure and that similar scales are used to measure this even though there are differences in their names. In this framework, different dual structures were used such as intuitive/sensate, thinking/feeling or rational/experiential (Pretz & Totz, 2007). Although people cannot escape from all cognitive and emotional responses, they need to be aware of them in order to overcome these biases, because it is difficult to change behavior without awareness (Baker, 2019).

The main purpose of this study is to classify biases, which is defined as the tendency of individuals to make mistakes, and to categorize them according to thinking styles, risky investment intention and subjective financial literacy. As discussed in detail in the literature review section, there is no consensus on the number of biases in the literature, and there is also not enough research regarding its classification. The general acceptance is that some biases are cognitive-based and some biases are affective-based. However, this distinction is based on conceptual knowledge rather than on any analysis. In this study, we aimed to make this classification using 1188 subjects based on the analyses. Categorization was done not only according to the cognitive and affective distinctions, but also according to the variables of risky investment intention and subjective financial literacy. Risk perception is important in the formation of biases. People's risk-taking or risk avoidance attitudes cause various tendencies. Also, financial literacy is important in preferences. Although there are significant relationships between objective financial literacy and subjective financial literacy, the two are different. Subjective financial literacy refers to the level of financial literacy individuals themselves have and is expected to have a stronger effect on biases.

In the second part, which is called the literature review, behavioral biases and risk aversion were explained in detail. The third part is the methodology, and in this section the purpose of the research, the data and scales used were mentioned. In the fourth part, the analyses conducted within the scope of the study and the findings obtained were reported. In the last part the conclusion, the research findings were evaluated, implications were made about the results and suggestions were made for future research.

Literature Review

Behavioral Biases

Behavioral finance research has defined many behavioral biases (Baker, 2019). However, there is no consensus on the number of biases and even their names (Peon et al., 2017; Ceschia et al., 2019). Blumenthal-Barby (2016) examined 214 studies on behavioral biases and found that there were 19 different biases and heuristics. Since there are very strong relationships between biases, almost none of them are found alone (Baker, 2019). While some of these biases completely overlap, some of them are completely opposite to each other (Baker & Ricciardi, 2014; Baker, 2019). However, there are very few studies that examined and classified biases in relation to each other (Ceschia et al., 2019). There is no consensus on these classifications (Peon et al., 2017; Ceschia et al., 2019; Baker, 2019).

Pompian (2006; 2008) first divided biases into two categaries, cognitive and emotional, based on his own experiences. Cognitive error is a definition or limitation of how people think (Baker, 2019). Cognitive biases are errors that occur when people collect, process and interpret information (Baker, 2019). Emotion is a mental state that arises spontaneously instead of conscious effort (Pompian, 2012). Emotional biases are decision-making behaviors based on emotions (Baker & Ricciardi, 2014). Emotional biases arise from impulses or intuitions rather than conscious calculations (Pompian, 2012). For this reason, a judgment is reached by how the information feels rather than by evaluating and analyzing it. Pompian (2006; 2008) lists cognitive biases as follows: ambiguity aversion, hindsight, framing, cognitive dissonance, recency (risk taking middle low); conservatism, availability, confirmation, representativeness, self-attribution (risk taking middle high). Emotional biases were also listed as follows: endowment, loss aversion, status quo, anchoring, mental accounting, regret aversion (risk taking low); overconfidence, self-control, optimism, illusion of control (risk taking middle high).

Aren & Canikli (2018a) followed Pompain (2008) and studied 19 biases with 100 subjects. However, rather than grouping biases, the authors examined changes according to active and passive investor characteristics and gender. Al-Dahana, Hasan, & Jadah (2019), referring to the study of Pompain (2006), evaluated biases in two groups. They evaluated cognitive bia-

ses as overconfidence, representativeness, availability, illusion of control, confirmation and hindsight bias, and they accepted emotional biases as loss aversion, endowment, self-control, regret aversion and status quo.

In the following years, Pompian (2012) divided cognitive biases into two groups: belief perseverance biases (conservatism, confirmation, representativeness, illusion of control, hindsight, cognitive dissonance) and information processing biases (anchoring and adjustment bias, mental accounting, framing, availability, self-attribution, recency). While belief perseverance biases indicate that individuals stay irrationally or illogically connected to their beliefs, information processing biases indicate that they process information illogically or irrationally (Pompian, 2012). Pompain (2012) accepts loss aversion, overconfidence, self-control, status quo, endowment, regret aversion as emotional biases. Similarly, Baker (2019) also divided biases into two: cognitive and emotional. While the author listed cognitive biases as confirmation, illusion of control, hindsight, framing, mental accounting and familiarity, listed emotional biases were overconfidence, optimism, loss aversion, regret aversion. Teovanović, Knezevic, & Stankov (2015) grouped seven cognitive biases under two factors with data consisting of 243 undergraduate students. Sahi, Arora, & Dhameja (2013), gathered the biases in the three groups, based on interviews with 30 people. In addition to these, Peon et al. (2017) divided biases into three groups. While the first group includes representativeness, anchoring, familiarity, hindsight, cognitive dissonance, aversion to ambiguity, overconfidence, self-attribution, confirmation and illusion of control, the second group included framing, loss aversion, mental accounting, conservatism, anchoring and self-control. Confirmation, familiarity and status quo occurred in the third group. However, this classification is not based on any analysis, and it is seen that some biases are in more than one group. Ceschia et al. (2019) also classified 17 heuristics and biases under three factors with 289 subjects, and the classification process was based only on internal correlation.

In this study, the biases in the studies of Pompian (2006; 2008), who used the widest bias list, were based. Accordingly, it was attempted to classify twenty biases analytically. The biases in the study are listed in Table 4.

1. Overconfidence: It is the overvaluation of an individual's knowledge and ability (Aren & Canikli, 2018a). It is accepted to be positively related to risk-taking (Lambert, Bessiere, & N'Goala, 2012; Broihanne, Merli, & Roger, 2014; Mota, Moreira, & Cossa, 2015) Findings regarding the amount of knowledge possessed and the relationship with financial literacy are complex. Menkhoff, Schmeling, & Schmidt (2013) and Mota et al. (2015) stated that there is a positive relationship with the amount of knowledge. While Anwar, Khan, & Rehman (2017) did not find a significant relationship with financial literacy, Rasool & Ullah (2020) stated that there was a negative relationship between them.

2. Illusion of control: It is the belief that people can control or at least affect the consequences of events (Aren & Canikli, 2018a). There is evidence that there is a negative relati-

onship with risk taking (Rasool & Ullah, 2020). In addition, Martinez, Le Floch, Gaffie, & Villejoubert (2011) determined that the illusion of control and risk-taking behaviors of the individuals may increase or not change according to the past event information given to the subjects. Hooks, Schuitema, & McDermott (2019) also state that individuals with the illusion of control tend to underestimate risks. Lam & Ozorio (2015), who studied Chinese subjects, could not find a significant relationship with risk taking Ateş, Coşkun, Şahin, & Demircan (2016) stated that it is positively related to financial literacy, and Smith & Giroux (2019), who evaluated the illusion of control in the context of gambling, also found that this bias would be more in well-educated people with more knowledge of probability and statistics.

3. Optimism: It is investors' positive opinions about the future, their own investments and financial decisions that are not based on a valid reason (Aren & Canikli, 2018a). It was reported to be positively associated with risk taking (Wang, Sheng, & Yang, 2013) and financial literacy (Ateş et al., 2016).

4. Self-Attribution: It is defined as individuals attributing their success to their personal abilities and their failures to bad luck (De Bondt, Muradoglu, Shefrin, & Staikouras, 2008). There are findings that there is a positive relationship with risk-taking (Jain & Kesari, 2019). Baker, Kumar, Goyal, & Gaur (2019) stated that there is a very strong relationship between self-attribution and overconfidence and that self-attribution leads to overconfidence, but they could not find a significant relationship with financial literacy. Czaja & Röder (2020) evaluated self-attribution and overconfidence together, considering self-attribution highly correlated with overconfidence (similar to Baker et al. (2019)), and both studies pointed out the positive relationship between self-attribution and risk taking.

5. Conservatism: It is to give more weight and trust to old information than new information (Ramiah, Xu, & Moosa, 2015). There are studies that found that conservative traders underestimate risks (Rahim, Shah, & Aamir, 2019) or avoid risk (Luo, 2013). It is accepted that there is also a positive relationship between financial literacy and conservatism (Kılınç & Kılıç, 2014).

6. Representativeness: It is the evaluation of an event or example according to its similarity to the main population in terms of its basic and salient characteristics (Kahneman & Tversky, 1972). It is thought that there is a positive relationship between risk-taking (Salman, Khan, & Javed, 2020) and a negative relationship with financial literacy (Rasool & Ullah, 2020). However, Baker et al. (2019) could not detect a significant relationship with financial literacy.

7. Regret Aversion: It is the desire to avoid negative emotion when individuals realize that it would be better if they had made a different choice (Zeelenberg, Beattie, Pligt, & Vries, 1996; Zeelenberg & Beattie, 1997; Humphrey, 2004; Reb, 2008; Van de Ven and Zeelenberg,

2011; Wong, 2014). Aren (2019b) states that there are both positive and negative relationships between regret aversion and risk taking. Hala, Abdullah, Andayani, Ilyas, & Akab (2020) could not find a relationship with financial literacy.

8. Framing: It is the decision maker making different choices according to presenting the same problem as gain or loss (Huangfu, 2014). There are findings that individuals want risk in case of loss and avoid risk in case of gain (Mishra, Gregson, & Lalumiere, 2011; Huangfu, 2014). It was found to be negatively related to financial literacy (Adamkovic, Martoncik, & Ropovik, 2020).

9. Cognitive dissonance: It is the tendency to eliminate the discomfort caused by inconsistent behavior by changing the behavior, preferences or changing the evaluation of the behavior that causes the arousal (Mannberg, 2012). It is accepted that this bias is positively associated with risk taking (Mannberg, 2012) but negatively associated with financial literacy (Ateş et al., 2016). However, while Beasley (2016) emphasizes that the cognitive dissonance theory is not a risk-taking theory, Meertens & Lion (2011) also point out that it will increase both risk aversion attitude of risk-averse individuals and the risk-taking attitudes of risk seeking people.

10. Recency: It is defined as believing that new information is more important than old information without rational justifications, and weighting the new information more in the decision phase (Aren, 2019a). Findings regarding its relationship with risk are complex (Aren, 2019a). Some researchers state that it increases risk-taking (Plonsky & Erev, 2017) and some researchers state it decreases it (Barron & Yechiam, 2009). It was reported to be negatively related to financial literacy (Avşar & Özdemir, 2020).

11. Hindsight: It is an individual's erroneous belief regarding that s/he predicted the outcome of an event (actually did not) (Aren, 2019a). It was predicted to be positively associated with risk taking (Cristina, 2009; Merkle, 2017) and negatively related to financial literacy (Rasool & Ullah, 2020).

12. Endowment: It is the positive difference between the price that those who own the asset wants to sell the asset and the amount that those who do not have the asset are willing to pay to buy (Aren, 2019a). It has been stated that it is positively associated with risk aversion indirectly (Aren, 2019a) and indirectly and negatively associated with financial literacy (List, 2003).

13. Status Quo: It has been defined as individuals prefer their current situation by high weight without any basis (Samuelson & Zeckhauser, 1988). It was reported to be positively associated with risk aversion (Maner, Gailliot, Butz, & Peruche, 2007) and financial literacy (Josef & Vera, 2017).

14. Loss Aversion: The fact that individuals are more sensitive to losses than gains are defined as loss aversion (Maggi, 2006). It was predicted to be positively associated with risk avoidance (Maggi, 2006) and negatively related to financial literacy (Ateş et al., 2016; Rasool & Ullah, 2020; Mrkva, Johnson, Gaechter, & Herrmann, 2020).

15. Anchoring: This bias, first expressed by Tversky and Kahneman (1974), expresses the commitment of individuals to a certain value without any basis while making a decision (Aren, 2019b). It was stated that it was positively associated with risk taking (Ayadi, Paraschiv, & Vernette, 2017; Jetter & Walker, 2017) and negatively related to financial literacy (Smith, Windschitl, & Bruchmann, 2013).

16. Mental Accounting: It is defined as categorization by dividing the expenses and income of individuals into different classes (Shefrin & Thaler, 1988). Muehlbacher & Kirchler (2019) found a positive relationship between mental accounting and financial literacy and emphasized that it could increase risk-taking.

17. *Ambiguity aversion*; It is defined as people's preference for risky situations over uncertain situations (Borghans, Golsteyn, Heckmann, & Meijers, 2009). Foltice & Rogers (2020) state that ambiguity aversion is associated with lower participation in stock markets and more conservative investment strategies, therefore, it is expected to be positively associated with risk avoidance. Dimmock, Kouwenberg, Mitchell, & Peijnenburg (2016) found a significant positive relationship between ambiguity aversion and financial literacy, albeit very low (0.04).

18. Self-control: It is deficiency in the ability to overcome impulses (Baumeister, 2002). It was found to be positively associated with risk-taking (Dickason & Ferreira, 2018; Ritika, 2020) and negatively related to financial literacy (Mehmood, Bashir, & Khan, 2019). However, Trehan & Sinha (2020) state that as financial literacy increases within the framework of retirement planning, self-control bias will decrease indirectly.

19. Availability: It is the prediction of the probability of an event occurring according to the ease of remembering (Tversky & Kahneman, 1973; Tversky & Kahneman, 1974; Shams, 2002; Kliger & Kudryavtsev, 2010; Javed, Bagh, & Razzaq, 2017; Chen, Cheng, Lin, & Chihwei, 2017; Kudryavtsev, 2018). It was found to be positively associated with risk-taking (Mouna & Jarboui, 2015) and negatively related to financial literacy (Mouna & Jarboui, 2015; Rasool & Ullah, 2020).

20. Confirmation: It is the tendency to seek and overweigh information that overlaps with individuals' beliefs and predictions, and to underweight or ignore non-overlapping information (Nickerson, 1998; Cipriano & Gruca, 2014; Nelson, 2014; Costa, Carvalho, Bruno, & Prado, 2017; Charness & Dave, 2017). It is accepted that there is a positive relationship between risk taking (Aren, 2019b) and financial literacy (Ateş et al. 2016).

Risk Aversion

Risk aversion refers to the level of risk that individuals do not want to accept or undertake (Aren & Hamamcı, 2020, 2021). Traditional finance states that homo economicus is generally risk-averse, whereas behavioral economists states that risk aversion is dynamic, that is, it changes according to loss or gain situations (Czerwonka, 2019). Unlike behavioral finance, Breuer, Riesener & Salzmann (2014) stated that risk aversion is generally accepted as a stable personal trait.

Risk aversion increases in negative situations, following, a decrease in financial decisions such as savings and investment is experienced (Sakha, 2019). Similarly, as individuals' risk-averse attitudes increase, their demand for risky assets also decreases (Gollier, 2002). In this context, risk aversion also significantly affects people's decisions to participate in risky markets (Dimmock & Kouwenberg (2010). In terms of financial crises, it has been seen that market shocks caused by crises increase risk aversion (Guiso, Sapienza & Zingales, 2018). Sakha (2019) determined that risk aversion was high during the 2008 crisis, but there was a decrease in risk aversion with the improvement that came two years after the crisis. He stated that these changes occurred as a result of micro and macro-shocks. He also mentioned that if individuals expect to live in worse conditions in the future, their risk aversion attitudes will increase. Likewise, Guiso, Sapienza & Zingales (2018) found that there was an increase in the risk aversion attitudes of financial investors after the 2008 crisis. Byder, Agudela & Arango (2019) also investigated the risk attitudes of mutual fund investors in Colombia, and as a result, they observed that after the crisis, women and self-employed individuals withdrew their money from risky assets faster than others.

In the literature review, it was observed that there is a relationship between demographic variables and risk aversion. In terms of gender, women were found to be more risk-averse than men (Charness & Gneezy, 2012; Halko, Kaustia & Alanko, 2012; Meziani & Noma, 2018). Cole, Sampson & Zia (2008) stated that the reason for the low level of financial literacy of women may be due to their low demand for financial instruments. There are different findings in the literature regarding the relationship between risk aversion and age. While Bucciol & Miniaci (2011) and Boyle et al. (2012) found that risk aversion increases with age, on the contrary, Bommier & Rochet, (2006) and Brooks et al. (2018) found an inverse relationship between age and risk aversion.

Methodology

The aim of this study was to classify biases commonly used in behavioral finance. As discussed in the literature review section, there is no consensus on the number of biases and there is not enough work on their classification. In this study, biases were classified in the context of both rational/experiential – affective and risky investment intentions and subjective financial literacy. The variables and scales used in this framework are listed in Table 2.

Table 2
Variables and Scales Used in Research

Variables	Items	Scales
Rational/Experiential –Affective	20	Pacini & Epstein (1999)
Risky Investment Intention	4	Aydemir & Selim (2017)
Subjective Financial Literacy	1	Aren & Canikli (2018b)
Biases	20	Developed by this article

Our undergraduate and graduate students, who voluntarily supported the collection of data, shared an online survey link on their social networks. Within the scope of this study, individuals over the age of 18 with the potential to invest were reached. In this way, 1188 subjects participated in the study between May 14 2020 – June 28 2020. Four demographic questions were asked, namely sex, age, education level and marital status. Against this, since the questions about the economic situation of the individuals reduced the notifications given to the other questions, a separate question was not asked about their economic situation. Two participants did not answer the four demographic questions. However, all subjects, including these two subjects, completely answered all other questions in the study. Five hundred and sixty seven (47.7%) of the subjects were male and 619 (52.1%) were female. Nine hundred and twenty seven (78%) were 20-30 age group, 164 (13.8%) 31-40, 53 (4.5%) 41-50 and 42 were 51 and over. Twenty (1.7%) subjects had a degree of primary school, 292 (24.6%) subjects had a degree of high school, 741 (62.4%) degree of undergraduate and 133 (11.2%) degree of master/doctorate graduates. Two hundred and thirty seven (19.9%) of the subjects were married and 949 (79.9%) were single. Accordingly, our participants were gender-balanced, young, single and highly educated.

Analyses

Confirmatory factor analysis aims to verify previously developed or determined structures (Yaşlıoğlu, 2017). In this context, since the rational/experiential-emotional (two-dimensional) and risky investment intention (one-dimensional) scales used in the study were previously developed structures, confirmatory factor analysis was performed on these variables using SEM. The AMOS program was used for analyses. The analysis results are presented in Table 3.

Table 3
Confirmatory Factor Analysis

CMIN/DF	RMSEA	GFI	IFI	CFI	TLI	NFI	RFI
4,364	0,053	0,929	0,950	0,950	0,943	0,936	0,927

CMIN/DF shows the ratio of chi-square to degrees of freedom (Kes, Şahin & Sevencan, 2021). While RMSEA, one of the fit values listed in Table 2, is a statistic that provides information about whether the population is compatible with the covariance matrix (Byrne, 2011), NFI compares the $\chi 2$ value of the statistical model with the $\chi 2$ value of the zero model

(Yaşlıoğlu, 2017). In addition, while GFI shows the extent to which the model measures the covariance matrix in the sample (Waltz et al., 2010), CFI is a model that predicts that there is no relationship between variables. TLI value was put forth to eliminate the effect of sample size (Yaşlıoğlu, 2017). CMIN / DF value was less than 5 and RMSEA value was approximately 0.05. Other indicator values were higher than 0.90, which is accepted as the threshold value. In this context, according to Table 3, the goodness of fit indicator values regarding the confirmatory factor analysis conducted for the three variables used in our study is quite good.

In addition to this, exploratory factor analysis was made since we developed the items regarding biases. The varimax rotation results obtained by exploratory factor analysis regarding the biases used in the study are reported in Table 4.

Table 4
Varimax Rotated Component Matrix

Biases and Items	**Components**			
	Factor 1	**Factor 2**	**Factor 3**	**Factor 4**
Overconfidence: *"If I have a month to research, I can choose the most profitable investment instrument for the next month."*	,706			
Illusion of Control: *"I believe that I can protect my investment from negative developments in the market when I analyze as necessary."*	,755			
Optimism: *"When making an investment decision, I always have a positive opinion about the return on investment."*	,587			
Self-attribution: *"If an investment instrument I bought yields a return above expectations, I take a credit for my own investment ability from this."*	,614			
Conservatism: *"After I make an investment decision, I stand behind my decision, even if the developments are negative."*	,560			
Representativeness: *"When I come across an investment instrument that I am foreign to, I evaluate it according to other investment instruments that I find similar."*	,397			
Regret Aversion: *"If everyone around me buys an investment tool whose price is not high for me and I do not believe that it will earn much and they say that it will have a big return, I also buy it at the expense of some loss to avoid regret."*		,661		
Framing: *"To be honest, when it is said that an investment instrument has a 70% chance of earning, I look more positively compared to saying that you can lose 30%."*		,486		
Cognitive Dissonance: *"Even if an investment I made does not provide the return I expected, I think it is worth to make an investment."*		,702		
Recency: *"When making an investment decision, I pay more importance to the latest information."*		,437		
Hindsight: *"I think, "I knew" beforehand some opportunities that provide high returns in the financial markets."*		,367		
Endowment: *"I do not accept market price offers to buy the stock or house inherited from my family; a higher offer must be made for me to sell."*			,586	

Biases and Items	Components			
	Factor 1	Factor 2	Factor 3	Factor 4
Status Quo: *"If there are financial preferences I have made since the past, I will not change them easily."*			,585	
Loss Aversion: *"For me, the pain of losing $100 is more than the happiness of winning $100."*			,640	
Anchoring: *"I do not sell an investment instrument I bought below my purchase price, regardless of market conditions."*			,534	
Mental Accounting: *"If I were to direct my savings to investment, I would make separate investments for my expenses (holiday money, education money, automobile money, etc.) and the risk of each investment would be different."*			,432	
Ambiguity Aversion: *"I prefer certain investments with low return, rather than high-return or lossy investments with high uncertainty."*			,355	
Self–Control: *"I would rather spend less today than save and spend more in the future"*				,351
Availability: *"I think that the most reported and mentioned investment instruments are more profitable."*				,718
Confirmation: *"I care more about the information that shows that the investment decision I made is correct rather than the information that shows that it is erroneous"*				,633
% of Variance	15,470	9,999	9,560	9,405
Reliability Analysis	0,766	0,622	0,594	0,529
KMO		0,898		
Bartlett's Test of Sphericity		$4732,721^{0,000}$		

According to Table 4, the KMO value, which indicates the adequacy of the data and its suitability for factor analysis, is above the threshold value, and Bartlett's Test of Sphericity is significant at a 0,000 error level. As a result of the factor analysis, four factors were obtained and which biases were collected under which factors are shown in Table 4. Reliability analysis results for factors are not very high but at an acceptable level (Aren, Nayman, & Özcan, 2021). The four factors formed according to the results of factor analysis and the biases in these factors are as follows:

Factor 1 (Overconfidence, Illusion of Control, Optimism, Self-Attribution, Conservatism, Representativeness)

Factor 2 (Regret Aversion, Framing, Cognitive Dissonance, Recency, Hindsight)

Factor 3 (Endowment, Status Quo, Loss Aversion, Anchoring, Mental Accounting, Ambiguity Aversion)

Factor 4 (Self–Control, Availability, Confirmation).

Following the factor and reliability analyses, a discriminant analysis was performed for each factor. Discriminant analysis enables the prediction of dependent categorical variables

by using independent variables in continuously variable property. Since the dependent variable was categorical, the success of the analysis was measured with the correct classification.

The main purpose of the study is to separate the biases into different groups (factors) and estimate each of them according to the variables of rational, experiential-affective, risky investment intention and financial literacy. For this reason, dependent variables were categorized as low or high. Thus, it was possible to determine the main determinants of the factors consisting of relevant biases for each subject.

The discriminant analysis results obtained within this framework are reported in Table 5.

Table 5

Discriminant Analyses for Factor 1, Factor 2, Factor 3 and Factor 4

Factor 1		**Structure Matrix**		**Canonical Discriminant Function Coefficients**		
Rational		0,520		0,379		
Experiential – Affective		0,623		0,695		
Risky Investment Intention		0,647		0,383		
Subjective Financial Literacy		0,600		0,416		
Constant				–6,054		
Function	Eigenvalue	Canonical Correlation	Wilks' Lambda	Chi-square	Sig.	Correct classification
1	0,139	0,349	0,878	153,721	0,000	%65,9
Factor 2		**Structure Matrix**		**Canonical Discriminant Function Coefficients**		
Rational		0,357		0,146		
Experiential –Affective		0,764		0,955		
Risky Investment Intention		0,638		0,429		
Subjective Financial Literacy		0,475		0,293		
Constant				–5,917		
Function	Eigenvalue	Canonical Correlation	Wilks' Lambda	Chi-square	Sig.	Correct classification
1	0,156	0,367	0,865	171,272	0,000	%66,4
Factor 3		**Structure Matrix**		**Canonical Discriminant Function Coefficients**		
Rational		0,123		0,013		
Experiential – Affective		0,966		1,390		
Risky Investment Intention		–0,078		–0,235		
Subjective Financial Literacy		0,008		–0,019		
Constant				–4,248		
Function	Eigenvalue	Canonical Correlation	Wilks' Lambda	Chi-square	Sig.	Correct classification
1	0,051	0,221	0,951	59,066	0,000	%62

Factor 4		Structure Matrix		Canonical Discriminant Function Coefficients		
Rational		–0,021		–0,349		
Experiential – Affective		0,882		1,238		
Risky Investment Intention		0,408		0,257		
Subjective Financial Literacy		0,369		0,268		
Constant				–4,588		
Function	Eigenvalue	Canonical Correlation	Wilks' Lambda	Chi-square	Sig.	Correct classification
1	0,126	0,335	0,888	140,779	0,000	%64,6

In Table 5, in the four discriminant analyses performed for each factor, the models were significant at 0,000 margins of error, and the correct classification success was respectively 65.9%, 66.4%, 62.0%, and 64.6%. These classification values are quite high. The structure matrices were evaluated according to the threshold value of 0.30. For Factor 1 and Factor 2, all values are higher than the threshold value, indicating that these variables have discriminant characteristics. The variable with discriminant characteristic for Factor 3 is experiential-affective. For Factor 4, three variables except rational have discriminant characteristics.

Equations describing each factor can be written with the help of the values in the canonical discriminant function coefficient column. According to this;

Factor 1 = –6,054 + 0,379 X_1 (Rational) + 0,695 X_2 (Experiential – Affective) + 0,383 X_3 (Risky Investment Intention) + 0,416 X_4 (Subjective Financial Literacy)

Factor 2 = –5,917 + 0,146 X_1 (Rational) + 0,955 X_2 (Experiential – Affective) + 0,429 X_3 (Risky Investment Intention) + 0,293 X_4 (Subjective Financial Literacy)

Factor 3 = –4,248 + 0,013 X_1 (Rational) + 1,390 X_2 (Experiential – Affective) – 0,235 X_3 (Risky Investment Intention) – 0,019 X_4 (Subjective Financial Literacy)

Factor 4 = –4,588 – 0,349 X_1 (Rational) + 1,238 X_2 (Experiential – Affective) + 0,257 X_3 (Risky Investment Intention) + 0,2689 X_4 (Subjective Financial Literacy)

Following the discriminant analysis, mean values of four factors for each variable were calculated and reported in Table 6.

Table 6

Mean for Factor 1, Factor 2, Factor 3 and Factor 4

	Factor 1	Factor 2	Factor 3	Factor 4	Mean
Rational	3,6972	3,6895	3,6032	3,5810	3,5880
Experiential – Affective	3,6466	3,7171	3,6346	3,7802	3,5324
Risky Investment Intention	2,9665	3,0219	2,7803	2,9675	2,7927
Subjective Financial Literacy	2,9700	2,9800	2,8100	2,9600	2,8100

When Table 6 above is examined, it is seen that each factor has different mean values for each variable. For each factor, some of these variables were high and some were low. However, in order to say that these differences are statistically significant, analyses of ANOVA and Duncan tests should be performed. For this purpose, we investigated how each factor has a characteristic structure according to rational, experiential, risky investment intention and subjective financial literacy values. ANOVA and Duncan tests were performed for each variable using SPSS and the results were reported in Tables 7, 8, 9 and 10. Then Table 11 is then prepared as a summary of these.

Table 7

ANOVA Analysis and Duncan Test for Rational

Factor	**Mean**	**Mean**
Factor 4	3,5831	
Factor 3	3,6053	
Factor 2		3,6917
Factor 1		3,6993
Sig.	,617	,864
ANOVA Score: F value	3,494* (significant at the 0.05 level)	

According to the ANOVA analysis for the "rational" variable, Factor 1 and Factor 2 have a higher rational mean. Factors 3 and 4 have lower means. While Factor 1 and Factor 2 became a subgroup, Factors 3 and 4 took part in the second subgroup. Since the significant values of both subgroups are well above 0.05, it is possible to say that both subgroups are quite stable.

Table 8

ANOVA Analysis and Duncan Test for Experiential

Factor	**Mean**	**Mean**
Factor 3	3,6346	
Factor 1	3,6466	
Factor 2		3,7171
Factor 4		3,7802
Sig.	,754	,098
ANOVA Score: F value	5,861** (significant at the 0.01 level)	

Similar analyses were made for the variable of "experiential" and reported in Table 8. While Factors 2 and 4 formed a subgroup with higher mean values, Factors 3 and 1 took part in the second subgroup with lower mean values.

Table 9

ANOVA Analysis and Duncan Test for Risky Investment Intention

Factor	**Mean**	**Mean**
Factor 3	2,7803	
Factor 1		2,9665
Factor 4		2,9675
Factor 2		3,0219
Sig.	1,000	,384
ANOVA Score: F value	7,150*** (significant at the 0.000 level)	

For risky investment intention, factors were grouped into two sub-groups. However, while this time Factors 1, 4 and 2 were gathered in the same subgroup with higher values, Factor 3 took part in the other subgroup with a lower mean value.

Table 10

ANOVA Analysis and Duncan Test for Subjective Financial Literacy

Factor	Mean	Mean
Factor 3	2,8109	
Factor 4		2,9623
Factor 1		2,9656
Factor 2		2,9766
Sig.	1,000	,809
ANOVA Score: F value	4,691** (significant at the 0.01 level)	

In this framework, the subjective financial literacy variable, in which individuals evaluate their own financial literacy levels, was used in the last ANOVA and Duncan analysis. While Factor 3 took part in a subgroup alone with a lower mean value, the other three factors have formed the other subgroup with higher mean values. As a result, according to these four ANOVA and Duncan tests results, factors show the features summarized in Table 11.

Table 11

Summary of ANOVA Analyzes and Duncan Tests

Factor	Biases	Rational	Experiential	Risky Investment Intention	Subjective Financial Literacy
Factor 1	Overconfidence, Illusion of Control, Optimism, Self-attribution, Conservatism, Representativeness	High	Low	High	High
Factor 2	Regret Aversion, Framing, Cognitive Dissonance, Recency, Hindsight	High	High	High	High
Factor 3	Endowment, Status Quo, Loss Aversion, Anchoring, Mental Accounting, Ambiguity Aversion	Low	Low	Low	Low
Factor 4	Self–Control, Availability, Confirmation	Low	High	High	High

According to Table 11, individuals who have biases gathered under Factor 1 have high rational tendencies but their experiential tendencies are low. In addition, their risky investment intentions and subjective financial literacy levels were also high. In spite of this, all dependent variable values of individuals with biases gathered under Factor 2 were high. Conversely, all dependent variable values of individuals with biases gathered under Factor 3 were low. While individuals who have biases gathered under Factor 4 have low rational tendencies, their tendencies regarding other variables are high. When the four factors are evaluated together, it can be seen that there is a clear distinction between the dependent variable values of individuals with these biases.

In addition, ANOVA and Duncan tests were conducted for each of the demographic variables of sex, age, education and marital status in terms of Factors 1, 2, 3, and 4, rational, experiential, risky investment intention and subjective financial literacy level. In none of the thirty-two (4 demographics x 8 dependents) analyses performed, no difference was detected between the groups at a significance level of 0.05. In other words, factors formed within the scope of the study (Factor 1–2–3–4) and dependent variables (rational, experiential, risky investment intention and subjective financial literacy) do not differ according to demographic variables.

In this context, the correlation analysis results for dependent variables are also reported in Table 12.

Table 12

Correlation Analysis Results

	Rational	**Experiential**	**Risky Investment Intention**	**Subjective Financial Literacy**
Rational	1	0,176***	0,236***	0,157***
Experiential	0,176***	1	0,173***	0,100***
Risky Investment Intention	0,236***	0,173***	1	0,299***
Subjective Financial Literacy	0,157***	0,100***	0,299***	1

Note: significant at the 0.000 level

The results shown in Table 12 are interesting. A negative correlation is generally expected between rational and experiential. However, according to these results, it was found that positive and significant (at 0,000 level) relationship between all variables. This shows us that individuals do not have to have either rational or experiential tendencies, they can have both at the same time. In fact, this finding supports the statement that System 1 and System 2 can be activated simultaneously, emphasized by Kahneman (2013) in the dual thinking system. Systems 1 and 2 are effective structures in the decision-making processes of individuals. While System 1 is fast, automatic, experiential and intuitive, System 2 relies on slow, cognitive, analytical and conscious choices. According to Kahneman (2013), System 1 generates the feelings, impressions and intentions that System 2 needs. While System 2, on the other hand, transforms the intuitions and impressions provided by System 1 into beliefs, it transforms impulses into conscious actions. The division of labour between systems is efficient, reduces effort and increases performance.

To the best of our knowledge, our study is the research conducted with the largest data on the topology of biases. For this reason, in addition to analyses made, separate analyses were performed for each of the bias. In this context, it was investigated whether each bias differs for four dependent variables (rational, experiential, risky investment intention and subjective financial literacy) and four demographic variables. Accordingly, the independent sample T-test was applied to variables using the SPSS program and the results are reported in Table 13.

Table 13

Independent Sample T-tests for Biases

		Rational		Experiential		Risky Investment Intention		Subjective Financial Literacy	
Overconfidence	Low	3,24	***	3,16	***	3,30	***	3,34	***
	High	3,50		3,52		3,68		3,71	
Illusion of Control	Low	3,09	***	3,16	***	3,23	***	3,27	***
	High	3,47		3,44		3,62		3,65	
Optimism	Low	3,19	**	2,94	***	3,13	***	3,25	***
	High	3,38		3,46		3,70		3,57	
Self-attribution	Low	3,20	***	3,19	***	3,34	***	3,35	***
	High	3,54		3,54		3,67		3,76	
Conservatism	Low	3,08	***	3,01	***	3,16	***	3,22	***
	High	3,37		3,38		3,55		3,52	
Representativeness	Low	3,31	***	3,26	***	3,41	***	3,45	**
	High	3,58		3,59		3,69		3,67	
Regret Aversion	Low	2,92	*	2,78	***	2,90	***	3,01	
	High	3,09		3,13		3,33		3,15	
Framing	Low	3,41	**	3,19	***	3,48	**	3,49	**
	High	3,60		3,67		3,68		3,71	
Cognitive Dissonance	Low	2,82	***	2,75	***	2,80	***	2,93	***
	High	3,09		3,10		3,42		3,27	
Recency	Low	3,29	**	3,28	***	3,37	***	3,39	***
	High	3,51		3,51		3,61		3,63	
Hindsight	Low	2,80	***	2,78	***	2,84	***	2,97	***
	High	3,15		3,14		3,46		3,31	
Endowment Bias	Low	3,43	***	3,34	***	3,57	**	3,62	
	High	3,72		3,73		3,76		3,68	
Status Quo	Low	3,28		3,02	***	3,38		3,38	
	High	3,40		3,48		3,34		3,33	
Loss Aversion	Low	3,31		3,15	*	3,33		3,30	
	High	3,28		3,33		3,21		3,24	
Anchoring	Low	3,31		3,20	**	3,29	**	3,36	
	High	3,36		3,40		3,46		3,31	
Mental Accounting	Low	3,28	***	3,34	*	3,38	***	3,37	***
	High	3,54		3,51		3,65		3,77	
Ambiguity Aversion	Low	3,29		3,21	**	3,38		3,38	
	High	3,41		3,43		3,37		3,37	
Self–Control	Low	3,25		3,09	***	3,28	*	3,29	**
	High	3,36		3,41		3,43		3,47	
Availability	Low	3,08		2,64	***	2,95	***	2,97	
	High	2,98		3,13		3,11		3,11	
Confirmation	Low	3,02		2,55	***	2,93	***	3,01	**
	High	3,08		3,23		3,32		3,24	

*** 0,000 error level

** 0,01 error level

* 0,05 error level

In Table 13 above, all the dependent variables (rational, experiential, risky investment intention and subjective financial literacy) were grouped as low and high. Then, an independent sample T-test was conducted for each variable and each bias. The results of 80 (20 biases x 4 variables) independent sample T-tests performed in this way were reported. As an example, to understand Table 12 more easily; the overconfidence value of individuals with low level of rationality is 3.24, and the overconfidence value of individuals with a high level of rationality is 3.50. In other words, individuals with a high level of rational have a higher tendency to be overconfident, and this situation is significant at a 0,000 error level. Individuals' tendency towards status quo, loss aversion, anchoring, ambiguity aversion, self-control, availability and confirmation biases is not related to the rational level. In other biases, the higher the rational level, the higher the tendency towards the relevant bias. On the other hand, as the experiential level increases, the tendency towards all biases increases. Status quo, loss aversion and ambiguity aversion are not associated with risky investment intention levels. The tendency towards other biases increases as risky investment intentions increase. Regret aversion, endowment, status quo, loss aversion, anchoring, ambiguity aversion and availability biases are also not associated with subjective financial literacy. The tendency towards other biases increases as the subjective financial literacy increases.

When looking at the change according to demographic variables, ANOVA analyses and an independent sample T-test was performed for four demographic variables (sex, marital status, age and education) for each bias. A total of 40 independent sample tests (20 biases and 2 demographic variables) were conducted for sex and marital status, and 40 ANOVA analyses (20 biases and 2 demographic variables) for age and education. It was observed that the tendency towards any bias does not change according to age, and only overconfidence and optimism biases differ according to education level. Remarkably, it was seen that individuals with the lowest education level (primary school) had a higher tendency towards overconfidence and optimism biases. However, the fact that there were only 20 people at this education level in the participant group may have been effective in this result. On the other hand, it was determined that the tendency to bias did not change according to sex (0.05 error level). According to marital status, there was only differentiation in ambiguity aversion (0.05 error level). Married people tend to more ambiguity aversion than single people.

Conclusion

General Review

As a result of the analyses, 20 biases subject to the research were grouped into four groups. Accordingly, overconfidence, illusion of control, optimism, self-attribution, conservatism, and representativeness were put in a group. While the second group included regret

aversion, framing, cognitive dissonance, recency, hindsight, the third group included endowment, status quo, loss aversion, anchoring, mental accounting and ambiguity aversion. In the last group, self-control, availability, and confirmation biases were included.

According to this classification, while the rationally, risky investment intention and subjective financial literacy level of the individuals with bias in the first group are high, the experiential feature is low. On the other hand, individuals with biases in the second group were at high levels for all four characteristics. Individuals with biases in the third group are the opposite of those in the second group, and they are at a low level in all characteristics. Individuals with biases in the last group are similar to those in the first group, but while their experiential levels, which is is one of the thinking styles, are high, their rational levels are low. Since relatively high data can be reached in the study, additional analyses regarding biases were also made. In this context, interesting findings were obtained. As the experiential level, one of the thinking styles, increases, the tendency towards all biases increases. On the other hand, as the rational level rises, the tendency to be overconfident, an illusion of control, optimism, self-attribution, conservatism, representativeness, regret aversion, framing, cognitive dissonance, recency, hindsight, endowment and mental accounting biases also increase. However the tendency towards status quo, loss aversion, anchoring, ambiguity aversion, self-control, availability and confirmation biases are not related to the rational level. In addition, status quo, loss aversion and ambiguity aversion biases are not associated with the level of risky investment intention. However, the tendency towards other biases increases as risky investment intentions increase. Regret aversion, endowment, status quo, loss aversion, anchoring, ambiguity aversion and availability biases are also not associated with subjective financial literacy. In spite of this, the tendency towards overconfidence, an illusion of control, self-attribution, conservatism, representativeness, framing, cognitive dissonance, recency, hindsight, mental accounting, self-control and confirmation biases increase as subjective financial literacy increases.

Finally, serious relationships between biases and demographic variables could not be determined either, grouped or individually.

Implications

Our study provides important findings for academic people and financial advisors. As far as we know in the literature, no other study classified biases based on a number of variables on this number of subjects. This study will provide an important basis for subsequent academic studies. In addition, the approach to classifying biases both empirically and theoretically is based on a cognitive and affective basis. Interestingly, as Kahneman (2013), who won a Nobel prize for his work in behavioral finance, emphasized in his dual thinking system that these two systems can be active at the same time. However, as far as we know, no study has

empirically emphasized that the tendency towards bias can be triggered by both thinking styles. This study is important in terms of revealing this. In addition, we showed that a classification based on thinking styles, risky investment intention and subjective financial literacy would be more accurate rather than demographic variables. Finally, empirical findings regarding the change according to the four variables expressed for each bias are provided. As highlighted in the literature review section, the findings regarding the relationship of biases to relevant variables are complex. With its data and inferences, this study has the potential to clarify a little bit about this complex situation.

As Pompian (2008) stated, it is easy to find customers in financial markets, but it is difficult to retain them and ensure that they stick to their portfolio for the planned period. The way to do this is to understand the customers and know their tendencies. Each investor has a tendency towards various biases. It is not very easy to detect them one by one. However, many financial fund management companies try to measure their risk appetite by applying different risk-seeking surveys to investors. Similarly, subjective financial literacy levels can be easily learned. With the help of our approach, it becomes possible to predict the biases that investors, whose thinking styles are measured, may have. This finding may make a significant contribution to the happy advisor-happy investor relationships. In addition, we reveal that demographic variables such as age, sex, marital status and education level, which are frequently used in the formation of investor profiles, are not really important in the tendency to bias.

Future Research

Although our study was conducted with a relatively large number of subjects, it does not have the feature of generalization and it does not have such a claim. However, thanks to 1186 participants, it points to a number of trends. When combined with future studies and findings from different countries, it is possible to provide generalizable findings. On the other hand, adding various psychological variables such as emotional and emotional intelligence will also be beneficial for investor taxonomy. Consequently, this work has the potential to provide a basis for further research. It can provide guidance in terms of the findings obtained for future studies to be done in the behavioral finance area.

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