

**INTERPLAY OF PERSONALITY AND BIASES ON INVESTMENT DECISION: A
CLUSTER ANALYSIS APPROACH****Ms. Puja Tiwari** (corresponding author)[\(tipuja239@gmail.com\)](mailto:tipuja239@gmail.com) (<https://orcid.org/0000-0002-3989-4692>)Research scholar, Faculty of Commerce, Banaras Hindu University, Varanasi. Uttar Pradesh,
India. Pin code: 221005**Ms. Asma****[\(110asma@gmail.com\)](mailto:110asma@gmail.com)**<https://orcid.org/0000-0002-6501-0897>)Research scholar, Faculty of Commerce, Banaras Hindu University, Varanasi. Uttar Pradesh,
India. Pin code: 221005**Ms. Sampada Tiwari**[\(sampadatiwari16@gmail.com\)](mailto:sampadatiwari16@gmail.com) (<https://orcid.org/0009-0004-7899-9958>)Research scholar, Faculty of Commerce, Banaras Hindu University, Varanasi. Uttar Pradesh,
India. Pin code: 221005**Abstract:**

Much has been written about biases both in the area of behavioural economics and finance. From assuming them to be a flaw in human behaviour to shortcuts in decision-making, there is a wide range of studies available. However, a common acceptance in all these studies is that biases are present in everyone and cast their impact on real-life decision-making either knowingly or unknowingly. This study endeavours to unveil how selected biases operate along with personality traits and eventually influence investment decisions. Three prominent biases viz., overconfidence bias, representativeness bias and loss aversion bias are selected. Cluster analysis is employed to segment investors into groups based on their personality and prominent bias. Five different clusters of investors emerged which is also supplemented by ANOVA to understand the difference between these clusters. Fascinating findings were obtained highlighting the role of bias and personality in respect of investment decisions. This study is the first to unveil the combined effect of personality and bias on investment decisions and hold insights both theoretical and practical.

Keywords: overconfidence bias, representativeness bias, loss aversion bias, big five personality traits, investment decision.

1. Introduction

Decision-making is a pervasive action in human life. Studies have shown that an individual makes numerous decisions in a day (Haselton et al., 2005). But not all of these decisions are equally important. The importance of different decisions is determined by their

respective resources invested, the stakes associated and future repercussions. Among many important decisions a person takes in life, investment decision is surely an extremely significant one to be taken by an individual. This significance arises due to the long-term repercussions of investment decision on an individual's financial security and wealth creation. And it involves his/her hard-earned money, so an incautious selection of investment avenue can surely jeopardize the expected return from the investment or may even lead to negative return. However, choosing where to invest and where not is a complicated process that involves consideration of a lengthy list of factors that can have a bearing on the return and safety of investment (Metawa et al., 2019).

Given such a wide range of information to be considered and limited time and energy at disposal, one cannot afford to waste his limited time in employing the rules of game theory or decision-tree technique. So, individuals naturally resort to decision-making shortcuts i.e., *biases* to arrive at the final call on their investment (Jain et al., 2023). These decision-making shortcuts i.e., biases save investors a major chunk of time and effort and help them to navigate through the plethora of information available in the market. While dealing with uncertain and unknown risky situations such biases come to rescue as they assist the brain in making faster judgements (Haselton et al., 2005).

Often the term “bias” carries a negative connotation with it. This negative connotation has been derived from its dictionary meaning. Cambridge Dictionary defines bias as “the action of supporting or opposing a particular person or thing in an unfair way, because of allowing personal opinions to influence your judgment” (Cambridge Dictionary, 2023). Here the phrase “an unfair way” connects with the idea of malpractice and injustice, thus making the term “bias” shadier. However, bias simply means the preference or inclination of any person towards a person, object, belief or cultural practice. From the arena of English literature, this word travelled in the domain of psychology in the early 1970s. It was introduced as “cognitive bias” by Amos Tversky and Daniel Kahneman (Wilke & Mata, 2012). Tversky and Kahneman coined this term during their research program on heuristics and biases. They were trying to find the mechanism behind the decision-making by human beings. They found that heuristics and biases play a crucial role in decision-making by assisting people in making quick decisions under the limited availability of time and information resources.

Here it is important to understand the fact that biases exist naturally in our system of thinking and processing (Sahi, 2017). Haselton et al., (2009) say that the human brain is well designed for important problems of survival and it is essentially not irrational. The study of biases helps in revealing the intricate functionality and design of the brain and thus it should not be considered as a flaw but as a design feature of the brain (Haselton et al., 2005). And the influence of such biases does not necessarily make any decision irrational. It becomes irrational when it is compared with the behaviour/decisions of hypothetical rational economic man (Sahi, 2017). As Herbert Simon rightly coined the “bounded rationality theory”, he tried to oppose the idea of “homo economicus” or “rational economic man”. The theory of bounded rationality simply explains that human decisions are subject to the availability of limited resources like time, information and his cognitive capacity. So, more or less every person depends upon a

certain degree of bias while making any decision in order to fill the gap between required and available resources necessary for decision-making.

Biases are naturally and inherently present in everybody, however, their type and intensity vary from person to person depending upon the personality make-up of an individual. Every personality trait is different from each other in its basic nature and characteristics and thus provides a favourable or unfavourable environment for the incubation of various cognitive biases, accordingly. Personality traits act like nuclei for any bias to thrive and shed its impact on the investment decision through them. The role of each personality trait in investment-decision making is very vibrant. Some of the traits promote investing while some hampers it.

Therefore, this study has made a humble endeavour to contribute in this direction by unveiling the impact of three such biases viz., overconfidence bias, representativeness bias and loss aversion bias. Exploring the previous studies on the relationship between biases and investment decision, it was found that the majority of studies had focussed on understanding how investors' decision varies depending on their biases in action (Kumar & Goyal, 2016; Kumar et al., 2021; Boussaidi, 2013; Jain et al., 2022). However, there was no study found that had aimed to segment the investors based on their dominant bias and personality composition. Previous studies have tried to find the direct association between big five personality traits and psychological biases, between big five personality traits and investment decisions and between the biases and investment decision. And all these studies have categorised their investors on the basis of either their dominant personality trait or on the basis of bias present in them. The present study is different from all the previous study in its approach to examine the association between the personality traits, psychological biases and investment decision and the technique to reveal this association.

As already discussed, that all the big five personality traits co-exist in an individual and the psychological biases do not germinate in isolation but it requires the fertile ground of host personality trait to germinate. Based on these facts, this study has used cluster analysis to divide the investors in various clusters depending upon personality traits and psychological biases. Further, to study the association between these clusters and investment decision ANOVA has been used. As the available literature shows that different personality traits and biases differently influences the investment decision of an individual investor. The present study expects this difference of association between the various clusters and investment decision as well. It aims to fill a research gap by adopting a cluster analysis approach and offering both theoretical and practical insights for investors and practitioners so that biases can be understood and dealt with in a better light.

The objective of this study is to better understand how these three biases operate in the larger framework of personality so that better decision can be taken by both investors and financial agencies. The present study aims to answer the following research objectives:

- To reveal the prominent segments of investors based on their dominant personality traits and dominant bias.
- To understand how different bias operate in big five personality traits framework.

- To explore how different segments of investors behave with regard to investment decision given their personality and biases composition.

This study is of significance to researchers in better understanding how these three biases operate in the personality makeup of the investors. The findings of the study would expand our understanding of the interplay of biases and investors personality. It would also offer valuable insights to investors themselves so that they can arrive at an optimum decision taking into consideration their personality combination and prominent biases. Investment agencies are also expected to also derive information on how to assist their clients in managing their portfolios by segmenting them based on their personality traits and prominent biases.

2. Literature Review and Hypothesis Development

2.1 Personality and Investment Decision: Personality is the most complex and extensive term to define. Baron & Misra (2022) in their book ‘Psychology’ have defined personality as those unique and stable patterns of behaviour, thoughts and feelings which makes an individual unique and distinct from other individual. For the present study we have opted for the Big Five Personality traits developed by Costa and McCrae for the measurement of personality as here our priority is to measure the traits of an individual investor in order to find the role of his personality traits in his investment decisions. These five traits are extraversion, agreeableness, conscientiousness, neuroticism and openness to experience. It is important to note here that all these five traits co-exist in an individual, but mostly his overt behaviour is guided by the dominant trait in his personality. This dominant trait influences various aspects of an individual’s life. Various studies have confirmed the role of the big five personality traits in determining the trading behaviour of investors (Durand et al., 2008; Pak & Mahmood, 2015). The role of personality traits in decision-making is a well-established fact. Here, we are trying to see the impact of big five personality traits on the investment-decision making of an investor Before going to the analysis portion, it is pertinent to know the connection between the big five personality traits and the investment-decision making as mentioned in the available literature.

Extraversion: As per the NEO-PI-R scale developed by Costa and McCrae, an extraversion personality trait represents six basic facets – warmth, gregariousness, assertiveness, activity, excitement seeking and positive emotions. A person high in extraversion enjoys talking to people and making new friends. They experience strong positive emotions such as ecstasy and enthusiasm (Costa & McCrae, 2010). Extraversion has a positive relation with the investment intention of investors as well (Sarwar, et al., 2020). Extroverts focus more on positive information which induces overconfidence in them, hence influencing their financial decision-making (Pan & Statman, 2013). The hyperactive nature of extrovert investors hinders them from resting in one place for a long period and so obstructs them from investing in long-term investment avenues as well. Hence, they find themselves more in short-term investing in comparison to other investors (Mayfield et al., 2008). However, the excitement-seeking trait of these investors positively influences their investment intention in the stock market (Jain et al., 2022).

Agreeableness: Goldberg, (1990) has suggested adjectives like unsuspecting, unenvious, genial, lenient, benevolent, courteous, diplomatic etc., to describe an individual

high in agreeableness traits. The primary objective of agreeable people is to build and maintain a congenial relationship (Heinstrom, 2010). They display more of a submissive attitude and, hence easily accept the decisions of an authoritative leader (Heinstrom, 2010). This behaviour has been highlighted in their investment decision as well. Their frequency of investment in the stock market is positively and strongly related to the information they receive from their friends and family members (Tauni et al., 2017).

Conscientiousness: A high score of conscientiousness trait represents an individual's compulsive behaviour, extreme morals, rigid self-discipline and determination towards goals and objectives (Mayfield et al., 2008). Their decisions are generally based on profoundly searched information. They put maximum effort and time in the search of correct and useful information before making any decision (Heinstrom, 2010). Conscientious individuals do not depend on the word-of-mouth information and misconceptions while making their investment decisions (Tauni et al., 2016; Sarwar et al., 2020). Conscientious individuals are extremely cautious, investigative, methodological and disciplined investors with very specific investment objectives. Eventually, these qualities make them less risk-tolerant. The correlation between conscientiousness and risk-tolerance has been found negative (Pak & Mahmood, 2015).

Neuroticism: This personality trait is associated with the emotional instability of an individual. Individuals scoring high for this trait are highly sensitive, vulnerable, self-conscious and nervous people (Costa & McCrae, 2010). They may also have unrealistic demands from life or people in their life. They also experience low self-esteem and often doubt their worth. Their reaction towards any positive or negative situation is extreme. These traits make them nervous and anxious during decision-making. Neurotic people are prone to hoard extra information to cope with the unfamiliar and unpredictable situations (Tauni, et al., 2017). Lack of analytical abilities and fear of failure make neurotics investor risk-averse (Pak & Mahmood, 2015). Their risk-tolerance capacity is comparatively lesser than other investors. This extremely low-risk appetite makes neurotics less enthusiastic investors, thus establishing negative relationship between neuroticism and investment intention (Sarwar et al., 2020).

Openness to experience: Individuals scoring high for this trait are imaginative, intellectual, curious, enthusiast and prefer trying new things in life (Mayfield et al., 2008). Such people have "unusual and unconventional thought" on any matter of life (McCrae & John, 1992). They have an invitational attitude towards new information or new ideas (Heinstrom, 2010). They are highly unconventional and creative in taking any decision. They are intellectual people, and they use same information in different way in decision making in comparison to other people. Individuals scoring high for this trait have strong and positive association with investment intention in stock market (Sarwar et al., 2020).

2.2 Psychological Biases and Investment Decision: Considering the role of biases in decision making, especially under the situation of risk and uncertainty, we have selected certain biases for our study to check the role of biases in investment decision making. Marking the uncertainty and risk involved in investment decision, the investors are expected to be biased (Sahi, 2017). Biases and heuristics help in making better decisions under complex situations (Sahi, 2017). Taking guidance from the available literature we have selected three important biases for our study based on their relation with the big five personality traits and their relation with the investment decision of individual investors mentioned in the literature. These biases are overconfidence, representativeness and loss-aversion.

Overconfidence bias: “Overconfidence bias is the tendency of people to overestimate their knowledge, abilities, and the precision of their information” (Ackert & Deaves, 2018). There are various forms of overconfidence bias. It can be present in the form of miscalibration (overestimation of own knowledge), better-than-average effect (when people rate themselves above average), illusion of control (misapprehension to have control over any future event), excessive optimism (Fellner & Krugel, 2012; Ackert & Deaves, 2018). People demonstrate more overconfidence for difficult task in comparison to easier one (Barber & Odean, 2001). Investment decision is one of such difficult tasks, hence investors are susceptible to overconfidence bias. Overconfident investors overestimate their knowledge about the value of financial security and remains optimistic about the precision of their evaluations in comparison to others (Barber & Odean, 2001). The bias gets strengthened from the past positive returns on the investment, which creates an illusion of control and self-attribution bias, making the investor believe that the positive return is the result of their decision in the bullish market and negative or lower than expected return occurred due to the external uncontrollable factors (Alsabban & Alarfaj, 2020; Abdin et al., 2022). Presence of overconfidence bias in an investor is subject to various factors like gender (Barber & Odean, 2001; Mishra & Metilda, 2015; Kumar & Goyal, 2016; Adil, Singh, & Ansari, 2022), financial literacy (Baker et al., 2019; Ozen & Ersoy, 2019) and personality trait (Sadi, Asl, Rostami, Gholipour, & Gholipour, 2011; Ahmad, 2020; Rasheed, Gul, & Hashmi, 2021). The susceptibility of overconfidence bias is detrimental to efficient investment decision. It makes the investor trade more, reduces his expected utility from the investment, decreases the return from the investment in long-run and hold more riskier asset in his portfolio (Barber & Odean, 2001; Ackert & Deaves, 2018).

Representativeness bias: It is a biasness in decision making caused by various heuristics involved in computing probability of any uncertain event. Representativeness bias is the tendency of people to associate occurrence or non-occurrence of any uncertain event with the probability of known similar event. People violate certain laws of statistics while making such probabilistic judgments based on the representativeness (Taffler, 2010). The laws that are being violated are insensitivity to prior information, insensitivity to sample size, misconception of chance and randomness, insensitivity to predictability and misconceptions of regression (Tversky & Kahneman, 2008). Representativeness bias helps the decision maker in making fast judgments based on the cues available to them. While facing any uncertainty, people try to match the situation with the best-known similar situation and make decisions accordingly. Another heuristic that causes the biased decision under representativeness is “overweighting the recent information over the past information”. Under this people make the recent event or information as the representative for the prediction of future event and ignores the past. Decision maker, here, quickly updates his prior information with the recent one. The representativeness bias causes an overreaction by the investors in the stock market (Boussaidi, 2013). A series of good or bad performances of a company is perceived as the representative of its future performance. Investors extrapolate this information and overreacts to any piece of new information about the company.

Loss-aversion Bias: This bias originated from the very famous Prospect Theory by Kahneman and Tversky in 1979. According to the experiments done by Kahneman and Tversky people value loss two times more than they value gain of similar amount (Kahneman, 2012). No body wish to incur loss willingly. Every person tries their best to protect themselves

from the loss. Loss-aversion bias simply reflects this tendency of people in financial decision making. To an individual, whether an investor or not, “losses loom larger than gain” (Kahneman, 2012). Unlike above two mentioned cognitive biases, overconfidence and representativeness, loss-aversion is an emotional bias (Pompian, 2006; Kahneman, 2012). In case of loss, the psychological index of emotional arousal tends to increase, and instead of responding, people react emotionally to losses. However, this emotional arousal under losses can be felt differently by different people, but it is not completely absent in any individual. In financial market, the loss-aversion bias is displayed through *disposition effect* (where an investor sell their winning stock, but hold on their losing stock), *endowment effect* (where an investor demands more to leave the holding stock, but will pay less in order to repurchase the same), and *status-quo bias* (where an investor is too afraid to change his position to lower the probability of incurring loss) (Pompian, 2006; Kahneman, 2012; Ackert & Deaves, 2018).

2.3 Hypothesis Development:

Based on the extant literature, and to attain the research objectives of this study following hypothesis has been postulated:

H₁: There is difference in investment decision between the observed clusters of investors.

3. Methodology

3.1 Data collection: To serve the purpose of our study, data has been collected through the structured questionnaire from the individual investors of Varanasi. The questionnaire was divided into two sections. The first section was designed to collect the demographic details of the individual investors through multiple choice questions. In the second section of the questionnaire, five-point Likert’s Scale was used to measure the personality traits, psychological biases and investment decision of individual investors. The details of adopted measurement scale and their respective sources id given in Table 1.

Constructs	Source	No. of Items
Extraversion (E)	Goldberg, 1999	5
Agreeableness (A)	Goldberg, 1999	5
Conscientiousness (C)	Goldberg, 1999	5
Neuroticism (N)	Goldberg, 1999	5
Openness to experience (O)	Goldberg, 1999	5
Investment Decision (ID)	Metawa, Hassan, Metawa, & Safa, 2019	5
Overconfidence Bias (OV)	Baker, Kumar & Goyal, 2018	5
Representativeness Bias (R)	Baker, Kumar & Goyal, 2018	3
Loss-Aversion Bias (LA)	Kumar, Dudani & K., 2021	3

Before data collection, pilot testing was conducted on 35 samples. After receiving the green flag from pilot testing data collection was started on 16th July 2023 and continued till October 2023. For data collection, online and offline questionnaires were distributed to 780 respondents. To gain the access of investors of Varanasi, convenience and snowball sampling was used. From the distributed questionnaires, 534 questionnaires were received from the respondents. Out of these 534 questionnaires, only 492 questionnaires were found to be usable in this study. The demographic details of the respondents are given in Table 2.

Demography	Range	Frequency	Percentage
Age	18-30 years	227	46.14%
	31- 40 years	114	23.17%
	41- 50 years	70	14.23%
	51-60 years	55	11.18%
	61 and above	26	5.28%
	Total	492	100%
Gender	Male	336	68.29%
	Female	156	31.71%
	Total	492	100%
Income	Less than 2.5 lakhs p.a.	56	11.38%
	2.5 – 5 Lakh p.a.	134	27.24%
	5- 10 Lakh p.a.	187	38.01%
	10 - 15 Lakh p.a.	50	10.16%
	More than 15 Lakh p.a.	65	13.21%
	Total	492	100%

Source: Author's computation

3.2 Scale Reliability and Validity: The reliability and validity of the constructs viz., extraversion, agreeableness, conscientiousness, neuroticism, openness to experience, representativeness, overconfidence bias, loss-aversion bias and investment decision, were measured through the confirmatory factor analysis. The details of which is given in Table 3 and Table 4. To measure the reliability of constructs Cronbach's alpha and composite reliability scores (ρ_c) were used. The Cronbach's alpha scores and composite reliability scores for all the constructs stood higher than the minimum threshold of 0.70 (Hair et al., 2019). This confirmed the existence of construct's reliability.

Further, the convergent and discriminant validity of the constructs were tested. Convergent validity was tested through Average Variance Explained (AVE) scores. The AVE scores for all the constructs are higher than the minimum threshold of 0.50 (Hair et al., 2019), which confirms the presence of convergent validity in constructs. For discriminant validity, HTMT correlation matrix were used. A perusal of Table 4 shows that all the values are below the maximum limit of 0.85 (Hair et al., 2019). Thus, the discriminant validity of our data stands established.

	Cronbach's alpha	(ρ_c)	(AVE)
Agreeableness	0.836	0.879	0.594
Conscientiousness	0.877	0.910	0.671
Extraversion	0.866	0.903	0.651
Loss-aversion	0.950	0.961	0.833
Neuroticism	0.902	0.927	0.718
Openness to Experience	0.886	0.915	0.684
Overconfidence	0.921	0.941	0.761
Representativeness	0.923	0.942	0.765

Investment Decision	0.921	0.922	0.701
----------------------------	-------	-------	-------

Source: Author’s computation

Table 4: HTMT Matrix

	A	C	E	ID	LA	N	O	OV	R
A									
C	0.317								
E	0.230	0.372							
ID	0.254	0.372	0.293						
LA	0.231	0.148	0.375	0.371					
N	0.125	0.238	0.179	0.711	0.282				
O	0.238	0.181	0.170	0.228	0.222	0.188			
OV	0.109	0.564	0.314	0.381	0.044	0.237	0.099		
R	0.075	0.544	0.066	0.196	0.394	0.112	0.169	0.773	

Source: Author’s computation

A is agreeableness, C is conscientiousness, E is extraversion, ID is investment decision, LA is loss-aversion bias, O is Openness to experience, OV is overconfidence bias and R is representativeness bias.

3.3 Data Analysis: The data analysis was conducted in two stages. In the first stage the cluster analysis was conducted to classify the investors on the basis of their personality traits and psychological biases. After classifying the investors in various clusters, ANOVA analysis was used to find their association with investment decision.

3.3.1 Cluster Analysis: The cluster analysis has been conducted in two stages. In the first stage the Hierarchical Clustering Technique was used to find the possible number of clusters. For this the average scores given by respondents for the big five personality traits and the three biases were employed to form the dendrogram. The dendrogram map revealed the possibility of making four or five clusters from the available clusters.

After finding the possible numbers of cluster, the next step involves formation of cluster. For this step, a non-hierarchical technique was used. The clusters were formed using k-means clustering technique for four and five clusters. The clusters appeared more informative and evenly distributed for five-clusters solution. The result of final cluster centres and cases in each cluster is given in Table 5.

Table 5: Final Cluster Centre and Number of Cases in Each Cluster

	Clusters				
	1	2	3	4	5
Extraversion	3.673	3.692	3.547	3.762	4.455
Agreeableness	4.371	3.659	3.611	3.816	3.610
Conscientiousness	3.595	3.795	3.376	4.559	3.827
Neuroticism	2.275	2.485	4.316	2.672	2.466
Openness to experience	3.546	4.515	3.232	3.533	3.431
Overconfidence	2.112	2.254	2.026	4.355	3.845
Representativeness	4.397	4.372	4.292	2.093	3.905

Loss-Aversion	4.309	1.949	4.326	4.383	1.903
Number of cases in each cluster	77	78	76	137	124

Source: Author’s computation

3.3.2 ANOVA: Analysis of variance was used to study the difference among the five clusters of investors with respect to investment decision. For this analysis, cluster memberships of the respondent investors were the independent variables and the mean score of investment decision was the dependent variable. The ANOVA result ($F = 331.407$, $p\text{-value} < 0.05$) shows that there is significant difference among the five clusters of investors with respect to investment decision. Thus, H_1 of our study stands accepted. The Table 6 presents the result of ANOVA. From the perusal of Table 6, it is evident that the Cluster 2 has the strongest association with investment decision as its mean score is 4.461, and Cluster 3 has the weakest association with the investment decision with the mean score of 2.194.

Before conducting the post hoc analysis, it is necessary to test the homogeneity of variance. For testing the homogeneity of variance, Levene statistic was used. The Levene statistic stood significant at $p < 0.05$, which means the homogeneity of variance is not expected. The relevant data is given in Table 6. Since, the homogeneity of variance is not expected, Dunnett T3 test was used for Post Hoc analysis (Table 7). The post hoc analysis made it evident that the investment decision of Cluster 3 is significantly different from the investment decision of all other Clusters. Similarly, the investment decision of Cluster 2 is different from the investment decision of Cluster 3 and Cluster 4 and the investment decision of Cluster 4 is significantly different from the investment decision of Cluster 2, Cluster 3 and Cluster 5.

Cluster	N	Mean	Test of Homogeneity of Variances		ANOVA	
			Levene Statistic	Sig.	F	Sig.
1	77	4.387	33.811	0.000	331.407	0.000
2	78	4.461				
3	76	2.194				
4	137	4.290				
5	124	4.406				
Total	492					

Source: Author’s computation

Dependent Variable: Investment-Decision				
	Mean difference	Significance	Lower Bound	Upper Bound
Cluster 1 - Cluster 2	-0.075	0.764	-0.216	0.067
Cluster 1 - Cluster 3	2.192	0.000	1.857	2.527
Cluster 1 - Cluster 4	0.097	0.169	-0.019	0.212
Cluster 1 - Cluster 5	-0.019	1.000	-0.143	0.104

Cluster 2 - Cluster 3	2.266	0.000	1.926	2.607
Cluster 2 - Cluster 4	0.171	0.003	0.039	0.303
Cluster 2 - Cluster 5	0.055	0.950	-0.084	0.194
Cluster 3 - Cluster 4	-2.095	0.000	-2.427	-1.765
Cluster 3 - Cluster 5	-2.211	0.000	-2.546	-1.878
Cluster 4 - Cluster 5	-0.115	0.036	-0.228	-0.004

Source: Author's computation

4. Discussion and Conclusion

This research made an effort to identify various clusters of investors based on their personality traits and psychological biases. This study also endeavoured to identify the difference among these clusters with respect to their investment decision. The study found five different clusters viz., Cluster 1, Cluster 2, Cluster 3, Cluster 4 and Cluster 5. The characteristics of these clusters and their association with investment decision are described below.

4.1 Cluster 1: In our data set, only 77 respondent investors belong to this cluster. The dominating personality trait of this cluster is Agreeableness. The dormant personality trait of this cluster is neuroticism. Further, this cluster have prominent presence of representativeness bias and loss-aversion bias. Among the five clusters, this cluster is most susceptible to the representativeness bias with the final cluster score of 4.397 for this bias. The investors of this cluster reflect absence or weak presence for overconfidence bias. From the ANOVA it is evident that this cluster has strong association with investment decision as the mean score is 4.387. The strong association of this cluster with investment decision lies in the characteristics of their dominating personality trait, i.e., agreeableness. This personality trait display more of a submissive attitude and, hence easily accept the decisions of an authoritative leader (Heinstrom, 2010). This behaviour has been highlighted in their investment decision as well. Their frequency of investment in the stock market is positively and strongly related to the information they receive from their friends and family members (Tauni et al., 2017). Their investment decisions reflect the urge for acceptance and coherence in social relations, and hence they become part of the market herd by reacting to such information provided by their social circle (Tauni, et al., 2017).

The post-hoc analysis reveals that the investment decision of this cluster is significantly different from the investment decision of Cluster 3. Here, it is interesting to note that the composition of personality traits and psychological biases of Cluster 1 is similar to the Cluster 3. The only difference between these two clusters is the presence of neurotic personality trait. Cluster 1 reflects absence or feeble presence of neuroticism personality traits, whereas, the dominating personality trait for the Cluster 4 is neuroticism. From the analysis, it became evident that the dominating personality traits are playing important role in making investment decision in comparison to psychological biases. It was observed from post-hoc analysis that

even Cluster 1 and Cluster 3 are susceptible to same bias, their investment decision varied significantly due to difference in their dominating personality traits. Hence, it can be concluded that dominant personality trait plays a major role in influencing the investment decision of individual investors and biases are just a part of that personality make-up.

4.2 Cluster 2: The second cluster of the study is composed of 78 respondent investors. The dominating personality trait of this cluster is Openness to experience and the dormant personality trait of this cluster is neuroticism. The investors of this personality trait are highly susceptible to representativeness bias and least susceptible to overconfidence bias and loss-aversion bias. For an open-to-experience investor, it is very obvious that he is susceptible to representativeness bias while making his investment decision as to deal with any uncertain and risky situation they immediately refer to their enriched experience base and fall prey to linking the new/unknown situation with similar past incidents. Further, their low association with overconfidence bias is the outcome of their positive association with intellectual humility (Porter & Schumann, 2018). This intellectual humility keeps them grounded and away from overconfidence bias. The curious, unconventional and creative nature of open to experience personality support their negative association with loss-aversion bias. This cluster also reflects the strongest association with investment decision with the mean score of 4.461 in comparison to other clusters. The investment decision of this cluster are significantly different from the investment decisions of Cluster 3 and Cluster 4.

Cluster 2 is different from Cluster 3 and Cluster 4 with respect to the psychological biases. Cluster 2 is only susceptible to representativeness bias whereas Cluster 3 with dominant personality trait of neuroticism is susceptible to representativeness bias and loss-aversion bias. Further, Cluster 4 with dominant personality trait of conscientiousness is highly susceptible to the overconfidence bias and loss-aversion bias.

4.3 Cluster 3: The number of respondents belonging to this cluster is 76. This is the smallest cluster in our study. The dominating personality trait of this cluster is Neuroticism and there is no dormant personality trait in this cluster as the cluster score of remaining four personality traits is higher than 3.000. The investors of this personality trait are highly susceptible to representativeness bias and loss aversion bias and least susceptible to overconfidence bias. This cluster also reflects the weakest association with investment decision with the mean score of 2.194. The investment decision of this cluster is significantly different from the investment decisions of all the other clusters.

The Cluster 3 is different from all the other Clusters in the composition of personality traits. As already discussed, all the personality traits co-exist in a person but some traits are prominent whereas other remain dormant or not so prominent. The personality trait of neuroticism is dormant in Cluster 1, Cluster 2, Cluster 4 and Cluster 5. It is dominant in Cluster 3 only. However, other personality traits, viz., agreeableness, extraversion, conscientiousness and openness to experience, are also moderately present in this Cluster as their respective Final Cluster scores are higher than 3.000 but lower than 4.000. It is important to notice here that the personality trait of neuroticism, which reflects the emotional instability of an individual is not the essential trait in investors. The cluster analysis reflects that investors whose dominant

personality trait is neuroticism have the weakest association with the investment decision. Also, all the other clusters in which neuroticism traits is dormant have a strong association with investment decision. Lack of analytical abilities and fear of failure make neurotic investors risk-averse (Pak & Mahmood, 2015) and make these individuals less enthusiastic investors, thus supporting a low or negative relationship between neuroticism and investment intention (Sarwar, et al., 2020).

4.4 Cluster 4: This is the largest cluster of our study as it includes highest number of respondent investors, which is 137. The dominating personality trait of this cluster is Conscientiousness and the dormant personality trait of this cluster is neuroticism. The investors of this personality trait are highly susceptible to overconfidence bias and loss-aversion bias. This cluster is least susceptible to representativeness bias. This presence of overconfidence bias and loss aversion bias is higher in this Cluster in comparison to the other clusters. This cluster also reflects a strong association with investment decision with the mean score of 4.290. The investment decision of this cluster is significantly different from the investment decisions of the Cluster 2, Cluster 3 and Cluster 5.

The Cluster 4 is significantly different from other clusters with respect to the dominating personality traits and the biases. This Cluster is the only cluster which has strongest presence of two psychological biases simultaneously. Further, it can be inferred that investors with dominating personality trait of conscientiousness are the most susceptible to overconfidence bias and loss-aversion bias in comparison to other investors. Conscientious investors rely very less on others information and trust their own knowledge and decisions. This extreme self-reliant tendency makes them highly prone to overconfidence bias and disposition effect (Ahmad, 2020).

4.5 Cluster 5: This is the second largest cluster of our study with 124 number of respondent investors. The dominating personality trait of this cluster is Extraversion and the dormant personality trait of this cluster is neuroticism. The investors of this personality trait are moderately susceptible to overconfidence bias and representativeness bias. The investors of this Cluster are least susceptible to loss-aversion bias. This cluster also reflects a strong association with investment decision with the mean score of 4.406. The investment decision of this cluster is significantly different from the investment decisions of the Cluster 3 and Cluster 4.

This Cluster is a very interesting cluster as it does not reflect the dominating presence of any bias. The investors with dominating personality trait of extraversion are moderately susceptible to overconfidence bias and representativeness bias but least susceptible to the loss-aversion bias. This personality trait is not extremely susceptible to any bias. This finding is interesting as several studies have found strong association between extraversion personality trait and overconfidence bias. Here, it is important to understand that the dominant feature of extraversion are warmth, gregariousness, assertiveness, excitement and sensation seeking and reflecting positive emotions. These features support the weak presence or absence of loss-aversion bias as the risk appetite of such people are more than other investors. However, due to their social interaction and high connectivity such people listen to the advice and suggestions

of others as well thus reflects moderate level of overconfidence bias. It would be better to comment that such individuals actually remain confident in their investment decisions rather than overconfident.

5. Implications

The present study has significant theoretical as well as managerial implications. This study is important for researchers and financial service providers. The study contributes to the literature by providing personality and psychological biases-based clusters and also the association of such clusters with investment decisions. Further, there are various studies that have used different approaches to study the influence of personality traits on psychological biases and investment decisions. This cluster approach is new and interesting.

The result of this analysis is important for the investors and the financial service providers. The result signifies that it is important for the individual investors themselves and for the agents or brokers to understand the personality traits of the investors. The investment decision of the investors is majorly decided by their personality make-up. Every individual investor belongs to a different cluster and behaves according to the composition of that investor. The cluster analysis has helped in categorising the heterogeneous investors in the homogenous groups based on their dominant personality traits, which is a relatively stable feature of investors, and psychological biases. For some clusters, any bias could be detrimental, whereas for some cluster the same bias could assist in decision-making. So, the knowledge of the cluster will definitely assist the investors and the investment agents in making better investment decisions.

6. Limitations and Future Scope

No research study is ultimate and we must acknowledge the limitations of study as there exist resources and efforts constraints in most studies. The limitations of research studies help us understand a given work in better light as well as pave ways for further studies on the same path. These limitations often offer beginning point for future research.

Limitation of our study include that we have taken only three biases and more biases can be added to future works. The present study was conducted on the only investors of Varanasi but this sample can be further expanded to several cities or a larger geographical area. This would offer a bigger picture as well as facilitate comparative studies.

Further studies may be undertaken by adding more biases such as ostrich bias, familiarity bias, herding bias etc to the conceptual model. Future researches may also adopt different methodologies like experimental design or mixed method approaches to better supplement the findings qualitatively and quantitatively. They can also bring moderation role of important demographic elements like gender, age, experience in investing etc to understand how biases might vary given such elements in play.

References

- Abdin, S. Z., Qureshi, F., Iqbal, J., & Sultana, S. (2022). Overconfidence bias and investment performance: A mediating effect of risk propensity. *Borsa Istanbul Review*, 22(4), 780-793. doi:<https://doi.org/10.1016/j.bir.2022.03.001>

- Ackert, L. F., & Deaves, R. (2018). *Understanding Behavioral Finance*. New Delhi: Cengage Learning.
- Adil, M., Singh, Y., & Ansari, M. S. (2022). How financial literacy moderate the association between behaviour biases and investment decision? *Asian Journal of Accounting Research*, 7(1), 17-30. doi:10.1108/AJAR-09-2020-0086
- Ahmad, F. (2020). Personality traits as predictor of cognitive biases: moderating role of risk-attitude. *Qualitative Research in Financial Markets*, 12(4), 465-484. doi:10.1108/QRFM-10-2019-0123
- Alsabban, S., & Alarfaj, O. (2020). An Empirical Analysis of Behavioral Finance in the Saudi Stock Market: Evidence of Overconfidence Behaviour. *International Journal of Economics and Financial Issues*, 10(1), 73-86. doi:https://doi.org/10.32479/ijefi.8920
- Al-Tamimi, H. A., & Kalli, A. A. (2009). Financial literacy and investment decisions of UAE investors. *The Journal of Risk Finance*, 10(5), 500-516. doi:10.1108/15265940911001402
- Baker, H. K., Kumar, S., Goyal, N., & Gaur, V. (2019). How financial literacy and demographic variables relate to behavioral biases. *Managerial Finance*, 45(1), 124-146. doi:10.1108/MF-01-2018-0003
- Barber, B. M., & Odean, T. (2001). BOYS WILL BE BOYS: GENDER, OVERCONFIDENCE, AND COMMON STOCK INVESTMENT. *The Quarterly Journal of Economics*, 261-292.
- Barberis, N., & Thaler, R. (2003). A SURVEY OF BEHAVIORAL FINANCE. In G. M. Constantinides, M. Harris, & R. Stulz (Eds.), *Handbook of the Economics of Finance* (pp. 1054-1123). Elsevier B.V.
- Baron, R. A., & Misra, G. (2022). *Psychology: Indian Subcontinent Edition* (5th ed.). Noida: Perason India Education Services Pvt. Ltd.
- Bilek, J., Nedoma, J., & Jirasek, M. (2018). Representativeness heuristics: A literature review of its impacts on the quality of decision-making. 29-38.
- Boussaidi, R. (2013). Representativeness Heuristics, Investor Sentiment and Overreaction to Accounting Earnings: The case of the Tunisian Stock Market. *Procedia- Social and Behavioral Sciences*, 81, 9-21. doi:10.1016/j.sbspro.2013.06.380.
- Buccioli, A., & Zarri, L. (2017). Do personality traits influence investors' portfolios? *Journal of Behavioural and Experimental Economics*, 68, 1-12.
- Cambridge Dictionary. (2023, June). (Cambridge University Press & Assessment 2023) Retrieved from Cambridge Dictionary: <https://dictionary.cambridge.org/dictionary/english/bias>

- Chen, G., Kim, K. A., Nofsinger, J. R., & Rui, O. M. (2007). Trading Performance, Disposition Effect, Overconfidence, Representativeness Bias, and Experience of Emerging Market Investors. *Journal of Behavioural Decision Making*, 20, 425-451. doi:10.1002/bdm.561
- Costa, D. F., Carvalho, F. D., Moreira, B. C., & Pardo, J. W. (2017). Bibliometric analysis on the association between behavioural finance and decision making with cognitive biases such as overconfidence, anchoring effect and confirmation bias. *Scientometrics*, 111, 1775-1799. doi:10.1007/s11192-017-2371-5
- Costa, P. T., & McCrae, R. R. (2010). *NEO Personality Inventory - Interpretive Report*. Florida: Psychological Assessment Resources(PAR), Inc.
- Durand, R. B., Newby, R., & Sanghani, J. (2008). An intimate portrait of the individual investor. *Journal of behavioural Finance*, 9(4), 193-208.
- Fellner, G., & Krugel, S. (2012). Judgmental overconfidence: Three measures, one bias? *Journal of Economic Psychology*, 33, 142-154. doi:10.1016/j.joep.2011.07.008
- Goldberg, L. R. (1990). An Alternative "Description of Personality": The Big-Five Factor Structure. *Journal of Personality and Social Psychology*, 59(6), 1216-1229.
- Goldberg, L. R. (1999). A broad-bandwidth, public domain, personality inventory measuring the lower-level facets of several five-factor models. *Personality psychology in Europe*, 7(1), 7-28.
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *Emerald Business Review*, 31(1), 2-24. doi:10.1108/EBR-11-2018-0203
- Haselton, M. G., Bryant, G. A., Wilke, A., Frederick, D. A., Galperin, A., Frankenhuys, W. E., & Moore, T. (2009). Adaptive rationality: An evolutionary perspective on cognitive bias. *Social Cognition*, 27(5), 733-763.
- Haselton, M. G., Nettle, D., & Andrews, P. W. (2005). The Evolution of Cognitive Bias. In D. M. Buss, *The Handbook of Evolutionary Psychology* (pp. 724-746). John Wiley & Sons.
- Heinstrom, J. (2010). *From Fear to Flow: Personality and information interaction*. Cambridge: Chandos Publishing.
- Jain, J., Walia, N., Singla, H., Singh, S., Sood, K., & Grima, S. (2023). Heuristic biases as mental shortcuts to investment decision-making: a mediation analysis of risk perception. *Risks*, 11(4), 72
- Jain, R., Sharma, D., Behl, A., & Tiwari, A. K. (2022). Investor personality as a predictor of investment intention - mediating role of overconfidence bias and financial literacy. *International Journal of Emerging Markets*. doi:10.1108/IJOEM-12-2021-1885.
- Kahneman, D. (2012). *Thinking, Fast and Slow*. New Delhi: Penguin Books.

- Kansal, P., & Singh, S. (2018). Determinants of overconfidence bias in Indian stock market. *Qualitative Research in Financial Markets*, 10(4), 381-394. doi:10.1108/QRFM-03-2017-0015
- Kumar, S., & Goyal, N. (2016). Evidence on rationality and behavioural biases in investment decision making. *Qualitative Research in Financial Markets*, 8(4), 270-287. doi:10.1108/QRFM-05-2016-0016
- Kumar, V., Dudani, R., & K., L. (2021). The big five personality traits and psychological biases: An exploratory study. *Current Psychology*. doi:<https://doi.org/10.1007/s12144-021-01999-8>
- Luo, G. Y. (2013). Can representativeness heuristic traders survive in a competitive securities market? *Journal of Financial Markets*(16), 152-164. doi:<http://dx.doi.org/10.1016/j.finmar.2012.05.001>
- Mayfield, C., Perdue, G., & Wooten, K. (2008). Investment management and personality type. *Financial Services Review*, 17, 219-236.
- McCrae, R. R., & John, O. P. (1992). An Introduction to the Five-Factor Model and Its Applications. *Public Health Resources*, 556, 175-215. Retrieved from <https://digitalcommons.unl.edu/publichealthresources/556>
- Metawa, N., Hassan, M. K., Metawa, S., & Safa, M. F. (2019). Impact of behavioural factors on investors' financial decisions: Case of the Egyptian stock market. *International Journal of Islamic and Middle Eastern Finance and Management*, 12(1), 30-55. doi:10.1108/IMEFM-12-2017-0333
- Mishra, K. C., & Metilda, M. J. (2015). A study on the impact of investment experience, gender, and level of education on overconfidence and self-attribution bias. *IIMB Management Review*, 27, 228-239. doi:<http://dx.doi.org/10.1016/j.iimb.2015.09.001>
- Morse, J. R. (1997). *Who is rational economic man*. USA: Social Philosophy & Policy Foundation.
- Oehler, A., Wendt, S., Wedlich, F., & Horn, M. (2017). Investor's Personality Influences Investment Decisions: Experimental Evidences on Extraversion and Neuroticism. *Journal of Behavioural Finance*. doi:10.1080/15427560.2017.1366495
- Ozen, E., & Ersoy, G. (2019). The impact of financial literacy on cognitive biases of individual investors. *Contemporary Studies in Economic and Financial Analysis*, 101, 77-95. doi:10.1108/S1569-375920190000101007
- Pak, O., & Mahmood, M. (2015). Impact of personality on risk tolerance and investment decisions. *International Journal of Commerce and Management*, 25(4), 370-384.
- Pan, C. H., & Statman, M. (2013). Investor personality in investor questionnaires. *Journal of Investment Consulting*, 14(1), 48-56.

- Pompian, M. M. (2006). *Behavioural Finance and Wealth Management*. New Jersey: John Wiley & Sons.
- Porter, T., & Schumann, K. (2018). Intellectual humility and openness to the opposing view. *Self and Identity*, 17(2), 139-162. doi: <https://doi.org/10.1080/15298868.2017.1361861>
- Qasim, M., Hussain, R. Y., Mehboob, I., & Arshad, M. (2019). Impact of herding behaviour and overconfidence bias on investors' decision-making in Pakistan. *Accounting*, 81-90. doi:10.5267/j.ac.2018.07.001
- Rasheed, M. H., Gul, F., & Hashmi, A. M. (2021). Personality Antecedents of Investors' Biased Behaviour in Pakistan. *International Journal of Scientific & Technology Research*, 10(4).
- Sadi, R., Asl, H. G., Rostami, M. R., Gholipour, A., & Gholipour, F. (2011). Behavioral Finance: The Explanation of Investors' Personality and Perceptual Biases Effects on Financial Decisions. *International Journal of Economics and Finance*, 3(5). doi:10.5539/ijef.v3n5p234
- Sahi, S. K. (2017). Psychological biases of individual investors and financial satisfaction. *Journal of Consumer Behaviour*(16), 511-535. doi:10.1002/cb.1644
- Sarwar, D., Sarwar, B., Raz, M. A., Khan, H. H., Muhammad, N., Azhar, U., . . . Kasi, M. K. (2020). Relationship of the Big Five Personality Traits and Risk Aversion with Investment Intention of Individual Investors. *Journal of Asian Finance Economics and Business*, 7(12), 819-829.
- Scott, J., Stumpp, M., & Xu, P. (2003). Overconfidence Bias in International Stock Prices- Consistent across countries and trading environments. *The Journal of Portfolio Management*, 80-89.
- Taffler, R. J. (2010). The Representativeness Heuristics. In H. K. Baker, & J. R. Nofsinger (Eds.), *Behavioral Finance: Investors, Corporations and Markets* (pp. 259-276). New Jersey: John Wiley & Sons.
- Tauni, M. Z., Fang, H. X., & Iqbal, A. (2016). Information sources and trading behaviour: does investor personality matter? *Qualitative Research in Financial Markets*, 8(2), 94-117. doi:10.1108/QRFM-08-2015-0031
- Tauni, M. Z., Fang, H. X., & Iqbal, A. (2017). The role of financial advice and word-of-mouth communication on the association between investor personality and stock trading behaviour: Evidence from Chinese stock market. *Personality and Individual Differences*, 108, 55-65.
- Tauni, M. Z., Rao, Z. R., Fang, H., Mirza, S. S., Memon, Z. A., & Jebran, K. (2017). Do investor's Big Five personality traits influence the association between information acquisition and stock trading behavior? *China Finance Review International*, 7(4), 450-477. doi:10.1108/CFRI-06-2016-0059

- Taylor, S. E., & Brown, J. D. (1988). Illusion and Well-Being: A Social Psychological Perspective on Mental Health. *Psychological Bulletin*, 103(2), 193-210.
- Thaler, R. H. (2000). From Homo Economicus to Homo Sapiens. *Journal of Economic Perspectives*, 14(1), 133-141.
- Tversky , A., & Kahneman, D. (2008). Judgment under uncertainty: Heuristics and biases. In D. Kahneman, P. Slovic, & A. Tversky (Eds.), *Judgment under uncertainty: Heuristics and biases* (pp. 3-19). New York: Cambridge University Press.
- Wilke, A., & Mata, R. (2012). Cognitive Bias. In V. S. Ramchandran, *Encyclopedia of Human Behaviour* (Second ed., pp. 531-535). Elsevier.