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Heuristic Biases as Mental Shortcuts to Investment Decision-Making: A Mediation Analysis of Risk Perception

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Abstract: In the last two decades, research on behavioural biases has grown dramatically, fuelled by rising academic interest and zeal for publication. The present study explores the mediating role of risk perception on the relationship between heuristic biases and individual equity investors' decision-making. The study uses Partial Least Square Structural Equation Modelling (PLS–SEM) to examine the survey data from 432 individual equity investors trading at the National Stock Exchange (NSE) in India. Risk perception is found to play a partial mediating role in the relationship amid overconfidence bias and investment decision-making, availability bias and investment decision-making, gamblers' fallacy bias and investment decision-making and anchoring bias and investment decision-making, whereas it is found to play the full mediating role in the relationship between representativeness bias and investment decision-making. The result of the present study provides valuable insights into the different behavioural biases of capital market participants and other stakeholders such as equity investors, financial advisors, and policymakers. The present study solely relied on the heuristic biases of individual equity investors. However, in the real world, many other factors may impact the investment decision of individual equity investors. This has been considered a limitation of the study. The present study solely relied on the heuristic biases of individual equity investors. However, in the real world, many other factors may impact the investment decision of individual equity investors. This has been considered a limitation of the study.

Keywords: heuristics; risk perception; investment decision-making; overconfidence; anchoring; gamblers' fallacy; PLS-SEM; PLS predict

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1. Introduction

One of the primary reasons for the intricacies in investment decisions is the existence of a massive number of participants who demonstrate various emotions and behavioural patterns while making investment decisions (Zahera and Bansal 2018). Traditional finance theories were based on the premise that markets are efficient and investors are rational. With the emergence of behavioural finance, the efficiency of the stock markets has become questionable as the various anomalies still need to be answered. Findings of Tversky and Kahneman (1974); De Bondt and Thaler (1995); Statman (1995, 1999); Gao and Schmidt (2005); and Evans (2006) reveal that individuals do not consider all the information while investing, and consequently they do not make rational decisions. Bernstein (1995) stated that human beings demonstrate incompetence, irrationality and inconsistency while taking investment decisions. Behavioural finance studies the impact of psychology on the behaviour of investors and financial analysts. It highlights the fact that the decision-making of the investors is swayed by the biases they possess (Jain et al. 2021, 2022; Pandit 2021; Gupta

et al. 2022). Investors lose their self-control, and therefore they do not behave rationally often. Scholz et al. (2021) found that even the recommendation from robo-advice is not free from behavioural biases, but effective financial advice can help individuals overcome these biases and make more informed and rational decisions (Ben-David and Sade 2001; Mugerman et al. 2020).

Zahera and Bansal (2019) found that individual investors are more prone to the disposition effect than institutional investors. Verma and Bansal (2021) found that macroeconomic variables also impact stock exchange performance. Mishra et al. (2023) discussed that attitude is the most important determinant in investment decisions. Sood et al. (2022) stated that out of the ESG factors, the governance criterion is discovered to be the most significant factor influencing individual equity investors' investment decisions. Most of the research relating to behavioural finance has been conducted in developed markets. Very few studies have been conducted in emerging markets like India so far. This paper adds to the existing literature by investigating the impact of behavioural factors on investment decision-making by taking risk perception as a mediator in India.

As behavioural finance is an emerging field, most of the empirical research studies (Daniel et al. 1998; Odean 1998; Barber and Odean 2000, 2001, etc.) have been conducted in developed nations, especially in the USA and there is lack of research in emerging economies (Kumar and Goyal 2015). The major reason for this could be that markets are at an earlier stage of development in developing countries. Although researchers in developing countries have been making efforts to conduct research in the field of behavioural finance in recent decades (Nga and Yien 2013; Kumar and Goyal 2015; Jain et al. 2021; Pandit 2021), yet very limited research has been carried out in India in this domain (Kent Baker et al. 2018). Other important reasons for conducting the study in India include (1) Developing economies suffer from the problem of financial literacy as compared to the developed nations (Zucchi 2018), which significantly impacts the behavioural biases of the equity investors (Rasool and Ullah 2020) and consequently their investment decision-making process; (2) Indian economy has become attractive to the equity investors because it has been found to receive nine times more equity investments directly in the stock market while comparing with any other equity market in the world (Ramadorai 2013; Kent Baker et al. 2018).

2. Literature Review and Hypothesis Formulation

2.1. Article Selection Process

Following the recommendations of Jain et al. (2021), the present study uses Scopus as the database to search the relevant literature. Scopus is one of the most comprehensive databases for retrieving social science literature (Aznar-Sánchez et al. 2019; Couckuyt and Looy 2019; Dias et al. 2020). In accordance with the recommendations of Bartolini et al. (2019), the current study identified the appropriate search terms by analysing the frequently used keywords in the peer-reviewed literature on behavioural biases. The keyword used for searching the literature includes "overconfidence", "cognitive biases", "loss aversion", "herding", "regret aversion", "psychological biases", "cognitive biases", "emotional biases", "representativeness", "gamblers fallacy", "anchoring", "mental accounting", "disposition effect", "risk perception of investors" and "investment decision-making". Inclusion/exclusion criteria were also applied for the selection of research articles. The inclusion/exclusion criteria include the following.

1. The current study looked at research papers published in English peer-reviewed journals (Saggese et al. 2016). All papers dealing with other languages are excluded from the scope of this study.

2. Following the recommendations of Patria et al. (2019), the current study examined academic studies published in economics and finance. As a result, the study excluded research on behavioural biases published in other domains.

2.2. Definition of Variables

2.2.1. Heuristics

Heuristics can be defined as the rule of thumb used by individuals for making decisions in a complex and uncertain environment. Investors often take irrational decisions using mental shortcuts rather than collecting and evaluating all the relevant information (Kahneman and Tversky 1979). When time is limited, people often use heuristics to making decisions. However, applying heuristics in decision processes usually results in bad decisions. Illusions stemming from using heuristics include overconfidence, representativeness bias, anchoring bias, availability bias, and gambler's fallacy bias (Waweru et al. 2008). Originally, Tversky and Kahneman (1974) defined heuristics by including three behavioural biases: representativeness, availability, and anchoring. Waweru et al. (2008) expanded the scope of heuristics by including overconfidence and gamblers' fallacy (Jain et al. 2021). The result of this section defines all the biases.

2.2.2. Overconfidence Bias

Overconfidence bias is a very frequent cognitive bias. Individuals suffering from overconfidence bias overestimate their skills, reasoning abilities, and exactness of information (De Bondt and Thaler 1995) for accomplishing their goals by miscalculating the potential uncertainties. Overconfident investors think their opinion is far more trustworthy than others (Jain et al. 2019).

2.2.3. Representative Bias

Representativeness bias is popularly known as familiarity bias. It means making a judgement with the analogy approach, in which decisions are likely to occur based on small samples because of the uncertainty involved (Busenitz and Barney 1994). When the information is not fully available, neural connections in the brain use shortcuts for processing information. Information processing is primarily done based on experience. Representativeness bias may lead investors to overreact, purchase hot scripts, and stay away from stocks that have shown poor performance in the past (De Bondt and Thaler 1995).

2.2.4. Anchoring Bias

Anchoring is the human inclination towards relying on small chunks of information (e.g., trading volumes, news, and one-day returns) while making investment decisions (Andersen 2010). It is an inclination of an investor towards investment decisions based on irrelevant price levels. Investors exhibiting this bias tend to fix the price based on past information (Waweru et al. 2008). Consequently, investors may need to be timelier and thus may be stuck buying the scripts at a higher price or selling the scripts at a lower price.

2.2.5. Availability Bias

It is an inclination of an investor towards relying upon easily available information instead of examining the available alternatives (Javed et al. 2017). Availability bias is exhibited when decision-makers put the onus on contemporary issues and available evidence while making investments. The latest incidents, which were personal experiences, became unforgettable. Furthermore, these unforgettable events are expected to be exaggerated and cause an emotional response. Investors tend to invest based on the availability of information and consequently make irrational decisions (Van den Steen 2004). Investors with availability bias typically invest in local companies/scripts and prefer investing in stocks recommended by well-known experts.

2.2.6. Gamblers' Fallacy

Chen et al. (2007) described the gambler's fallacy as the action that assumes a greater or less likelihood of anything occurring with a given probability if the cycle is replicated. It is also known as the 'Monte Carlo Fallacy' or 'The fallacy of the maturity of chances'. The stock market investors are driven by the gambler's fallacy which refers to the mistaken

belief of an investor that a recurring event in the past is less likely to reoccur in the future and vice versa, despite it being established that the probability of such events does not depend on past events.

2.2.7. Peer Effect

The investment decision of an individual can be significantly affected by a peer group. An individual may be more persuaded to follow suit and invest in lower-risk options if his or her social network contains risk-averse investors. However, an individual investor may be more likely to invest in highly risky assets if his/her peers are doing so. Studies have shown that peer effects can have a strong impact on investment decisions, particularly in areas where information asymmetry is high, such as the stock market. As a form of social proof, investors may rely on the actions of their peers, believing that if others invest in the same asset, it must be a good investment. Studies of investor peer relationships and peer pressure are provided by Mugerman et al. (2014); and Lu and Tang (2019).

2.2.8. Risk Perception

Risk perception is a biased judgement individuals make about the risks' features and severity. Perceived risk is one's opinion (belief) about the probability of risk (the possibility of exposure to loss, harm, or danger) connected with engrossing in a particular activity (Ricciardi 2008). Risk perception comprises attitudes, individual beliefs, feelings, judgments, social and cultural values, and dispositions. Risk perception plays a significant role in the decision-making process of equity investors (Pidgeon et al. 1992). Throughout the history of any society, risk perception has reflected the temper of the times of each society, as the emphasis has shifted from instinct to measurements and back (Bernstein 1995). If the individuals perceive that they have no control over their characteristics, the entire outcome of risk-taking will depend upon chance. It is well-known that most investors need control over the return from equity shares. Therefore, equity investments are perceived to be risky Mittal and Jhamb (2016).

2.2.9. Investors' Decision-Making

Investment decision-making refers to the decisions made by the investors about the number of funds to be deployed after looking at various investment avenues. Simply, it is about deciding the assets in which an individual will deploy the funds. There are numerous factors that can cause individual investors to deviate from the theoretical ideal of a Rational Economic Man proposed by early economists (Thaler 2000). Most investors need more skills and knowledge to comprehend the information and efficiently make the best financial decisions (Kahneman 2003). Individuals may be heavily affected by behavioural biases to varying degrees (Barberis and Thaler 2003). Even if we go with the traditional finance theories believing that everyone possesses the ability to interpret information, still access to the information is only equal for some (Glosten and Milgrom 1985). Understanding the investors' decision-making is highly important because such decisions play a vital role in defining the financial well-being of individuals. Additionally, the values of assets, market trends, and the efficiency of the capital markets are all ultimately determined by investor decisions and collective views (Mittal et al. 2020).

2.3. Hypothesis Formulation

Behavioural finance theories draw their base from cognitive psychology, which advocates that the decision-making of human beings is subject to numerous cognitive illusions. Cognitive illusions can be classified into two categories: heuristic-induced illusions and illusions brought on by using mental frameworks, which form part of prospect theory. The present paper considers the heuristics and tries to discover the influence of heuristics on investment decision-making in the presence of risk perception as a mediator.

2.4. Overconfidence Bias (OC) and Risk Perception

Overconfidence is a heuristic which has been taken from psychology. People with overconfidence bias usually overrate their knowledge, ability, and skills (Hvide 2002). Nofsinger (2017) further claims that overconfident investors overrate their knowledge and miscalculate the risk involved in an investment. Overconfident investors trade excessively in the stock market (Evans 2006). Overconfident people strongly believe they are above-average individuals, and such people usually have positive perceptions about themselves, which is unrealistic (Cooper et al. 1988; Taylor and Brown 1988). Overconfidence and risk perception both have a strong impact on the risk-taking behaviour of professionals (Broihanne et al. 2014). Overconfidence bias lowers an individual's risk perception about a strategy's riskiness (Russo and Schoemaker 1992; Barnes 1984). Chuang and Lee (2006) established that investors with overconfidence bias rely more on their private information and ignore publicly available information. Overconfident investors witness positive and negative surprises, making the financial markets inefficient because of their wrong forecasts (Shefrin and Thaler 1988). Jain et al. (2019) also established that overconfidence bias is among the most influential criteria influencing individual equity investors' decision-making.

2.5. Availability Bias (AVAIL) and Risk Perception

Tversky and Kahneman introduced the availability heuristic in 1973. It states that people should assess the likelihood of events based on their accessibility or how quickly they can find pertinent information. The reliance on the availability heuristic gives birth to several other systematic biases. Investors suffering from availability bias rely upon readily available information rather than examining other alternatives and procedures (Folkes 1988). Individuals dealing in the stock market are also swayed by the information they receive during the selection and identification of stocks (Haley and Stumpf 1989). Investors' preferences change as per the availability of information (Harris and Raviv 2005); consequently, a particular leading pattern and irrelevant information also impact investment decision-making. Irrelevant information negatively influences investment decision-making based on the risk-taking behaviour of the investors (Grable et al. 2004). Results of numerous past studies reveal that investors take their decisions comfortably if they possess superior information (Wang et al. 2011). Whenever any firm in the financial market reveals misconduct, investors receive a negative signal and quickly jump to a conclusion (Paruchuri and Misangyi 2015). Availability of risk is often expected to influence the risk perception of the individuals since the ease at which people in a particular situation visualize or recall possible consequences of a decision will decide the perceived risk, which is associated with the decision and the situation (Barbosa and Fayolle 2007). Availability of information may also increase the significance of earlier experience in determining perceived risk, as experienced events can be recalled easily (Slovic et al. 1982). Barbosa and Fayolle (2007) further clarified that new information framed positively reduces risk perception, and negative framing of new information increases risk perception. Therefore, the availability of information impacts the risk perception level. The conceptual framework is presented in Figure 1.

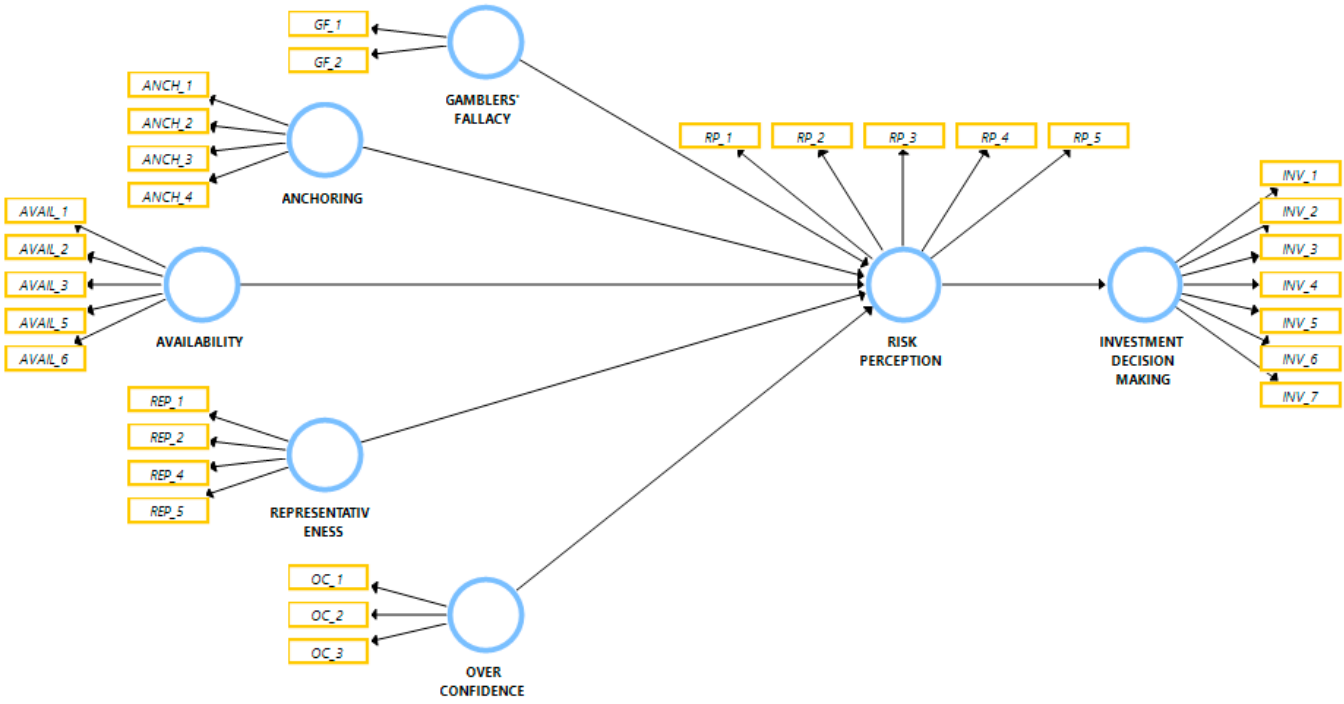

Figure 1. PLS-SEM Model.

2.6. Anchoring Bias (ANCH) and Risk Perception

Anchoring refers to the inclination of the investors towards predicting the value by assuming the "initial value" or default number (Pompian 2011; Shiller 1999). Representativeness relates to Anchoring in the sense that investors rely on their experiences gained in the recent past and become optimistic during the upward trend of the market and pessimistic during the downtrend of the market (Shiller 1999). Previous stock prices are considered anchors by investors for predicting future stock prices. Anchoring is the human tendency to rely on one piece of information (e.g., news, trading volumes, one-day returns) while taking investment decisions (Andersen 2010). Investors suffering from anchoring bias focus primarily on popular stocks because their attention is captured by such information, and it motivates them to accept that such stocks are valuable. Tversky and Kahneman (1974) claim that anchoring heuristics does not occur when the initial value is given but when reliable information is absent. Thus, the investors use past price trends as 'anchors' to forecast future returns, and the resultant impact is the occurrence of anomalies in the stock market. Investors also estimate the earnings of the company based on past trends (Waweru et al. 2008). An exciting relation between anchoring bias and risk perception occurs when individuals evaluate conjunctive and disjunctive events Juliana et al. (2022). Probabilities in the case of conjunctive events are usually overestimated, whereas probabilities in disjunctive events are often underestimated (Tversky and Kahneman 1974).

2.7. Representativeness Bias (REP) and Risk Perception

Representativeness bias means judging with the analogy approach, in which decisions are likely to occur based on small samples because of the uncertainty involved (Busenitz and Barney 1994). In financial markets, Representativeness bias can be observed when investors refer to buying 'hot' stocks and avoid dealing in stocks that have shown poor performance in the past. This type of behaviour justifies investors' overreaction (De Bondt and Thaler 1995). Individuals tend to classify events as traditional or indicative of a well-known class and emphasize the importance of such a classification. For example, when the quarterly earnings of a company show an upward trend in a row for several quarters, in such a case, investors generally predict a higher rate of growth in future earnings Barberis and Huang (2001), Xue and Zhang (2017) mentioned that in the process of spontaneous

decision-making during an emergency, faced with ambiguity of the scene and information and the time constraint, the consequences of representativeness bias on risk perception can be divided into two parts: firstly, it is hard for decision-makers to recognize the failure cases and causes of previous decisions. Therefore, successful decision-making in the past becomes the reference for future decisions, leading to over-optimism and will help in dealing with emergency decisions. Secondly, when such an arrangement is carried out over an extended period, similar thinking patterns create positive opinions in decision-makers' minds. As a result, it reduces their risk perception.

2.8. Gamblers' Fallacy Bias (GF) and Risk Perception

Daniel et al. (2002) reported that the paradox of gambler's fallacy is an erroneous presumption believing that if a random event happens more often than predicted over a period, the same is less likely to occur in future. Chen et al. (2007) described the gambler's fallacy as the action that assumes a greater or less likelihood of anything occurring with a given probability if the cycle is replicated. Gambler's fallacy can also be defined as erroneously assuming that a small sequence of events indicates a larger event when the sequence is independent. Gambler's fallacy is also known as the Law of Small Numbers, the Law of Maturity of Chances and the Monte Carlo Fallacy. The belief in the law of small numbers is apparent when an individual's decision-making is based on limited information (Hogarth 1981; Tversky and Kahneman 1974). Many researchers claim that individuals use limited amounts of positive information to make overly optimistic estimates (Barnes 1984; Kahneman and Lovallo 1993).

Furthermore, Schwenk (1986) contends that managers can persuade their followers to believe in the law of small numbers to gain support for risky actions. Likewise, the greater propensity of businesspeople to use limited information in decision-making (Busenitz and Barney 1994) indicates that confidence in the rule of small numbers may have influenced one's understanding of risk when choosing to launch a new venture. Thus, the above-mentioned empirical references indicate that the gambler's fallacy influences individuals' risk perception.

2.9. Risk Perception (RP) and Investment Decision-Making

Perception is an element involved in the thought-processing process of the mind through the senses, such as seeing, hearing, and feeling. Perception is influenced by information, and consequently, it impacts judgment. Risk perception is a mode for interpreting risks, which are diverse from estimates or thoughts and reality. Grima et al. (2021) mentioned that the higher the presence of bias in an individual's behaviour, the lower the individual's perception of risk. Risk perception plays an important role in guiding human behaviour, especially related to decisions taken in an uncertain environment (Forlani and Mullins 2000). An individual considers a situation risky when he suffers a loss due to a bad decision, which harms his financial condition. Hence, risk perception is a judgment made by an individual on a risky condition which is highly dependent on the psychological characteristics of the individual (Wulandari and Iramani 2014). Many researchers agree that risk perception influences investment decision-making (Keyes 1985; Bromiley and Curley 1992; Krueger and Dickson 1994; Sutcliffe 1994), but the nature of the relationship could be more consistent. Generally, it is expected that when the level of perceived risk increases, an individual is less likely to engage in risk-taking behaviour (Staw et al. 1981; March and Shapira 1987; Dunegan 1993), but the evidence proves that it is not the case always. Kahneman and Tversky (1979) explored that decision-makers with negative problem framing perceive high levels of risk and react with risk-taking behaviour.

2.10. Risk Perception as a Mediator

Risk perception plays an important role in the decision-making process of individuals and, thus, in the decision-making process of equity investors (Pidgeon et al. 1992). Ricciardi (2004) has provided a list of behavioural biases that affect an individual's perception of risk,

including heuristics, overconfidence, prospect theory, loss aversion, representativeness, framing, anchoring, etc. Many studies conducted in the past have supported the fact that behavioural biases affect the risk perception of investors (Barnes 1984; Russo and Schoemaker 1992; Slovic et al. 1982). Similarly, numerous studies have been conducted that justify that risk perception affects the decision-making process of individuals (Keyes 1985; Bromiley and Curley 1992; Krueger and Dickson 1994; Sutcliffe 1994). The discussion mentioned above shows that risk perception is affected by behavioural biases, and risk also affects individuals' decision-making. Risk perception becomes a dependent variable as regards its relationship with behavioural biases and becomes an independent variable regarding its relationship with investment decision-making. As risk perception plays the role of the dependent and independent variables, it is justified to take risk perception as a mediator.

Based on the literature review, the following hypothesis and methodology to be applied are proposed for the study:

H1: *Risk perception positively mediates the relationship of overconfidence bias with the investor's decision-making.*

H2: *Risk perception negatively mediates the relationship of availability bias with the investor's decision-making.*

H3: *Risk perception positively mediates the relationship of anchoring bias with the investor's decision-making.*

H4: *Risk perception positively mediates the relationship of representativeness bias with the investor's decision-making.*

H5: *Risk perception positively mediates the relationship of the gambler's fallacy with the investor's decision-making.*

3. Research Methodology

3.1. Questionnaire Design

As the study aimed to test the cause-and-effect relationship between behavioural biases and investment decision-making, the present study used the self-administered questionnaire for data collection. The survey instrument was pre-tested by 30 respondents, including ten experts and twenty equity investors, to confirm that measurement items are properly worded and understandable (Kumar et al. 2013). The necessary changes they suggested were incorporated into the questionnaire before the final collection of data. The final questionnaire consisted of two sections. Demographic information was assessed in Section I through questions on gender, age, educational qualification, annual income, and investment experience in the stock market. Section II consisted of statements drawn from relevant literature for measuring behavioural biases and investment decision-making.

3.2. Sample and Data Collection Procedures

Past research establishes that when there is difficulty in the accessibility of population (Wagner 2014), requisite of a specific type of population (Nardi 2018) and there exists the presence of an interconnected network of people or organizations, in such a scenario, non-probability snowball sampling is the most suited method of data collection in research. Accordingly, the present study employed a non-probability snowball sampling technique for data collection, as the population is of a specific type (i.e., investors), and they are from an interconnected network of stock exchanges. The target population for the present research includes individual investors investing in equity stocks in the Indian stock market. Data were collected from March to May 2021 using online and offline modes. To fill out the questionnaire, participants were contacted through a variety of means, such as emails, WhatsApp groups, and personal visits. Data were gathered from individual investors residing in Punjab's top eight highest-populated cities as per a census survey in 2011. The data were collected from the eight major cities of Punjab, namely Amritsar,

Ludhiana, Jalandhar, Patiala, Bathinda, Hoshiarpur, Mohali, and Batala. The rationale behind conducting the present study in Punjab is that the chosen state is among India's top five leading states in terms of new equity registrations (Limaye 2019).

Originally 600 questionnaires were distributed, and 493 responses were received, giving a response rate of 82.16%. Further, incomplete questionnaires were removed and a final data set of 432 was used for the study. Hoe (2008) and Singh et al. (2016) proposed that a sample size of 200 and above offers adequate statistical power for data analysis. Tabachnick and Fidell (2013) suggested that a sample size of 300 is adequate, which is further justified by Costello and Osborne (2019); and Williams et al. (2010). For the present study, sampling adequacy was also checked with the help of G*Power software (Faul et al. 2009). This technique requires a minimum sample size of 178 respondents for a 95% level of confidence. Therefore, a sample size of 432 respondents is adequate for the present study. The indicators forming part of different latent variables were taken from prior studies. Exploratory Factor Analysis (EFA) results revealed that indicators REP_3, AVAIL_4, GF_3, and INV_8 did not load onto any latent variable and hence were removed from the study. The results for the remaining statements are given in Table 1.

Table 1. Indicators, Mean, SD, and EFA loadings.

Loadings	SD	Mean	Adapted From	Indicators	
0.846	1.392	2.796	Kengatharan and Navaneethakrishnan (2014)	You believe that your skills and knowledge of the stock market can help you to outperform the market	OC 1
0.846	1.453	2.94	Phan and Zhou (2014)	You can predict the timing to enter and exit the market. Thus, you can outperform the market	OC 2
0.892	1.404	2.923	Phan and Zhou (2014)	You believe that your knowledge about the stock market can help you outperform your peers	OC 3
0.849	1.399	2.923	Huberman (2001)	You prefer to invest only in familiar stocks	REP 1
0.839	1.447	2.915	Waweru et al. (2008)	You buy 'hot' stocks and avoid stocks that have performed poorly in the recent past	REP 2
0.892	1.372	2.828	Marwaha et al. (2014)	If other stocks of a company are performing well and the same company offers new shares, you will buy the same	REP 4
0.809	1.467	2.798	Marwaha et al. (2014)	Even if your best-researched stock does not perform according to your expectations, you still hold the same	REP 5
0.885	1.375	3.052	Kengatharan and Navaneethakrishnan (2014); Waweru et al. (2008)	You rely on your previous experiences in the market for your next investment	ANCH 1
0.85	1.45	3.017	Baker and Nofsinger (2002)	You usually invest in a stock which has fallen considerably from its previous closing or all-time high	ANCH 2
0.842	1.391	3.037	Kengatharan and Navaneethakrishnan (2014)	You forecast the changes in stock prices in the future based on recent stock prices	ANCH 3
0.871	1.449	3.01	Waweru et al. (2008)	You use the purchase price of stocks as a reference point in trading	ANCH 4
0.754	1.394	3.334	Shikuku (2014); Waweru et al. (2008)	You prefer to buy local stocks than the trade in international stocks	AVAIL 1
0.771	1.44	3.282	Parker and Decotiis (1983); Khan (2017)	You prefer to invest in a stock that well-known experts have evaluated	AVAIL 2
0.705	1.356	3.18	Parker and Decotiis (1983); Khan (2017)	Your investment decision depends on new and favourable (positive) information released regarding the stock	AVAIL 3

Table 1. *Cont.*

Loadings	SD	Mean	Adapted From	Indicators	
0.727	1.336	3.234	Parker and Decotiis (1983); Khan (2017)	You prefer to buy stocks on the days when the value of the index increases	AVAIL 5
0.743	1.38	3.252	Parker and Decotiis (1983); Khan (2017)	You prefer to sell stocks on the days when the value of the index decreases	AVAIL 6
0.89	1.473	2.768	Waweru et al. (2008)	You are normally able to anticipate the end of good or poor	GF 1
0.913	1.479	2.781	Rakesh (2013)	You tend to ignore the benefits that can accrue by investing in different investment options	GF 2
0.725	1.373	3.192	Khan (2017)	You usually have a fear of investing in stocks that have a sure gain	RP 1
0.725	1.417	3.287	Khan (2017); Mallik et al. (2017)	You are cautious about stocks which show sudden changes in price or trading activity	RP 2
0.735	1.404	3.157	Khan (2017); Mallik et al. (2017)	You usually have worry investing in stocks that have had a past negative performance in trading	RP 3
0.688	1.414	3.279	Khan (2017)	You usually consider the credibility of brokerage firms that provide the financial services	RP 4
0.775	1.477	3.309	Khan (2017); Mallik et al. (2017)	You are often not afraid to invest in stocks that have shown a past positive performance in trading	RP 5
0.761	1.417	2.519	Sarwar and Afaf (2016); Khan (2017)	In general, you feel satisfied with the way you are making investment decisions	INV 1
0.715	1.41	2.544	Sarwar and Afaf (2016)	Your decision-making helps you to achieve your investment objectives	INV 2
0.734	1.4	2.544	Sarwar and Afaf (2016)	You are confident about the accuracy of your investment decisions.	INV 3
0.726	1.362	2.556	Sarwar and Afaf (2016)	Your investments decisions can mostly earn a higher-than-average return in the market	INV 4
0.662	1.327	2.621	Sarwar and Afaf (2016)	You make all investment decisions on your own	INV 5
0.747	1.37	2.551	Sarwar and Afaf (2016); Khan (2017)	You consider all possible factors (viz., interest rate, inflation, global factors, political factors, etc.) while making investment decisions	INV 6
0.708	1.417	2.541	Sarwar and Afaf (2016)	Return on your portfolio justifies your investment decision	INV 7

4. Analysis

The PLS-SEM approach is causal-predictive, which can explain casualty among constructs besides letting researchers examine the predictive quality of the results (Hair et al. 2017). The complex models comprising many indicators can be analysed using this technique without complying with distributional assumptions of multivariate normality (Hair et al. 2019). As the present study is focused on predicting the investment decision behaviour of an investor by analysing the causality among variables, PLS-SEM is most suited. SmartPLS (v. 3.2.9) software (Ringle et al. 2015) has been used to assess the conceptual model.

4.1. Descriptive Analysis

The profile of the respondents is given in the following Table 2.

Table 2. Demographic profile of respondents.

73%	Male	Gender
27%	Female	
9%	Below 20	Age
48%	20–35	
31%	35–50	
12%	Above 50	
8%	Undergraduate or lower	Educational Qualification
23%	Graduate	
69%	Postgraduate or higher	
6%	Below two lakhs	Annual Income
35%	2 lakhs to 5 lakhs	
48%	5 lakhs to 10 lakhs	
11%	10 lakhs and above	
23%	Below 2 years	Experience in the stock market
41%	2–5 years	
29%	5 to 10 years	
7%	10 years or above	

Source: Authors.

4.2. Analysis of Measurement Model

Confirmatory Composite Analysis (CCA) was conducted to assess the measurement model (Hair et al. 2020). The values of Composite Reliability were more than 0.7, while the AVE (average variance extracted) was more than 0.50 mark (Table 3). The outer loadings were more than 0.708, except for INV_4 (Table 3). However, it was retained as the AVE for INV was more than 0.5. All the outer loadings were significant, with t statistics greater than 1.96. This established the measurement model's internal consistency and convergent validity (Hair et al. 2019).

Table 3. Composite Reliability, AVE, and Outer Loadings.

AVE	Composite Reliability	Outer Loadings	Items	Construct
0.708	0.879	0.858	OC_1	Overconfidence
		0.869	OC_2	
		0.795	OC_3	
0.597	0.881	0.855	AVAIL_1	Availability
		0.754	AVAIL_2	
		0.749	AVAIL_3	
		0.773	AVAIL_5	
		0.725	AVAIL_6	
0.708	0.906	0.834	ANCH_1	Anchoring
		0.82	ANCH_2	
		0.912	ANCH_3	
		0.795	ANCH_4	

Table 3. *Cont.*

AVE	Composite Reliability	Outer Loadings	Items	Construct
0.665	0.887	0.87	REP_1	Representativeness
		0.737	REP_2	
		0.743	REP_4	
		0.899	REP_5	
0.747	0.854	0.943	GF_1	Gamblers' fallacy
		0.778	GF_2	
0.697	0.92	0.795	RP_1	Risk Perception
		0.812	RP_2	
		0.776	RP_3	
		0.854	RP_4	
		0.929	RP_5	
0.613	0.916	0.845	INV_1	Investment decision-making
		0.775	INV_2	
		0.821	INV_3	
		0.631	INV_4	
		0.75	INV_5	
		0.871	INV_6	
		0.764	INV_7	

Source: Authors.

Further, the discriminant validity was established using HTMT ratios (Table 4) of less than 0.85 (Henseler et al. 2015; Hair et al. 2020). Other criteria suggested by Fornell and Larcker (1981) were assessed where the correlation of a construct with any other construct should be less than the square root of the AVE of that construct (Hair et al. 2019). The condition was met and is presented in Table 5. Additionally, there was no problem with cross-loadings in the results. Hence, discriminant validity is sufficiently proved.

Table 4. HTMT ratio.

RP	OC	INV	GF	ANCH	AVAIL	
					0.332	ANCH
				0.039	0.217	GF
			0.359	0.387	0.74	INV
		0.39	0.122	0.145	0.226	OC
	0.428	0.723	0.431	0.334	0.529	RP
0.454	0.233	0.414	0.192	0.213	0.32	REP

Table 5. FL Criterion.

REP	RP	OC	INV	GF	ANCH	AVAIL	
						0.772	AVAIL
					0.841	−0.334	ANCH
				0.864	0.025	−0.212	GF
			0.783	0.358	0.389	−0.74	INV
		0.841	0.388	0.12	0.145	−0.226	OC
	0.835	−0.429	−0.722	−0.426	−0.336	0.531	RP
0.816	−0.457	0.23	0.419	0.191	0.214	−0.323	REP

Note: The values in bold represent the square root of AVE.

4.3. Analysis of Structural Model

The structural model was evaluated following Hair et al. (2017); and Hair et al. (2019). Additionally, the guidelines given by Carrion et al. (2017) and Nitzl et al. (2016) were followed to test the mediation effects. First, the collinearity was analysed using the VIF values, which came to be less than 3. Thus, the collinearity was fine in the study. Further, the

Bootstrapping technique with 4999 subsamples (Henseler et al. 2016) was utilised to assess the significance of hypothesised mediation effects. The analysis was done at a significance level (α) equal to 0.05, and 1.96 is the table value for t-statistics at the corresponding level.

Risk Perception (RP) was found to mediate the relationship between OC and INV (ß = 0.086, t = 3.66). The direct effect of OC on INV was also significant with ß = 0.102 and t statistics = 2.826. Hence, there was complementary partial mediation (both the coefficients being positive; VAF = 45.74%) providing support for H1. Similarly, H2 was also supported, and the nature of mediation observed was partial and complementary. A significant negative indirect effect for AVAIL ⊚ RP ⊚ INV (ß = −0.098, t = 4.846) and significant and negative direct relation for AVAIL ⊚ INV (ß = −0.473, t = 7.516) upheld the H2. Likewise, complementary partial mediation was observed between ANCH and INV and between GF and INV with a significant indirect effect (ANCH⊚RP⊚INV: ß = 0.049, t = 2.524; GF⊚RP⊚INV: ß = 0.096, t = 3.904) and a significant direct effect (ANCH⊚INV: ß = 0.091, t = 2.492; GF⊚INV: ß = 0.091, t = 2.562). H3 and H5 were supported. A significant indirect effect for REP⊚RP⊚INV (ß = 0.072, t = 3.301) but an insignificant direct effect REP ⊚ INV (ß = 0.053, t = 1.253) indicated that RP fully mediates between REP and INV. Thus, H4 was supported. The results are presented in Table 6.

Further, the model exhibited moderate explanatory power with the values of r2 for RP (0.536) and INV (0.721) well above 0.50 (Hair et al. 2019). Next, the value of effect size (f2) was examined. In explaining INV, AVAIL (f2 = 0.549) depicted a large effect size (i.e., more than 0.35), and RP indicated a medium effect with f2 = 0.185 (i.e., more than 0.15). The effect size for ANCH (0.025), GF (0.024) and OC (0.03) was small (more than 0.02), and for REP (0.008) was negligible in explaining INV (Cohen 2013).

Finally, the study assessed the predictive relevance of the model with the help of the Q2 value (Geisser 1974) and PLSpredict (Shmueli et al. 2016). The value of blindfolding-based Q2 for the key endogenous construct INV was 0.413. Hence, the model showed medium predictive relevance (Hair et al. 2019).

The model's predictive power was also examined with the PLSpredict procedure (Shmueli et al. 2019). The results in Table 7 indicated that the value of Q2 prediction for each item of key endogenous latent variable INV was more than 0. Subsequently, the PLS MV Prediction errors were analysed. An observation of the plots of PLS errors for all indicators of INV (Figure 2) suggests that the errors were highly non –symmetrically distributed. Hence, PLS MAE values were compared with LM MAE for every indicator of INV (Table 7). PLS MAE yielded smaller values for most indicators than LM MAE, indicating medium predictive relevance (Shmueli et al. 2019).

Table 6. Path Analysis.

Decision	VAF	Type of Mediation	Mediation	Significant (Yes/No)	*p*-Value	t Statistics	ß	Path	Effect	Hypothesis
Supported	45.74%	Complementary	Partial	YES YES	0 0.005	3.66 2.826	0.086 0.102	OC◎RP◎INV OC◎INV	Indirect Direct	H1
Supported	17.16%	Complementary	Partial	YES YES	0 0	4.846 7.516	−0.098 −0.473	AVAIL◎RP◎INV AVAIL◎INV	Indirect Direct	H2
Supported	35.00%	Complementary	Partial	YES YES	0.012 0.013	2.524 2.492	0.049 0.091	ANCH◎RP◎INV ANCH◎INV	Indirect Direct	H3
Supported	-	-	Full	YES NO	0.001 0.21	3.301 1.253	0.072 0.053	REP◎RP◎INV REP◎INV	Indirect Direct	H4
Supported	51.34%	Complementary	Partial	YES YES	0 0.01	3.904 2.562	0.096 0.091	GF◎RP◎INV GF◎INV	Indirect Direct	H5

Source: Authors.

Table 7. Results of PLSpredict.

LM	PLS	PLS	Indicator
MAE	MAE	Q^2 Predict	
0.862	0.854	0.408	INV_1
0.878	0.873	0.349	INV_2
0.813	0.829	0.456	INV_3
1.008	0.987	0.229	INV_4
0.851	0.842	0.353	INV_5
0.767	0.801	0.457	INV_6
0.905	0.911	0.308	INV_7

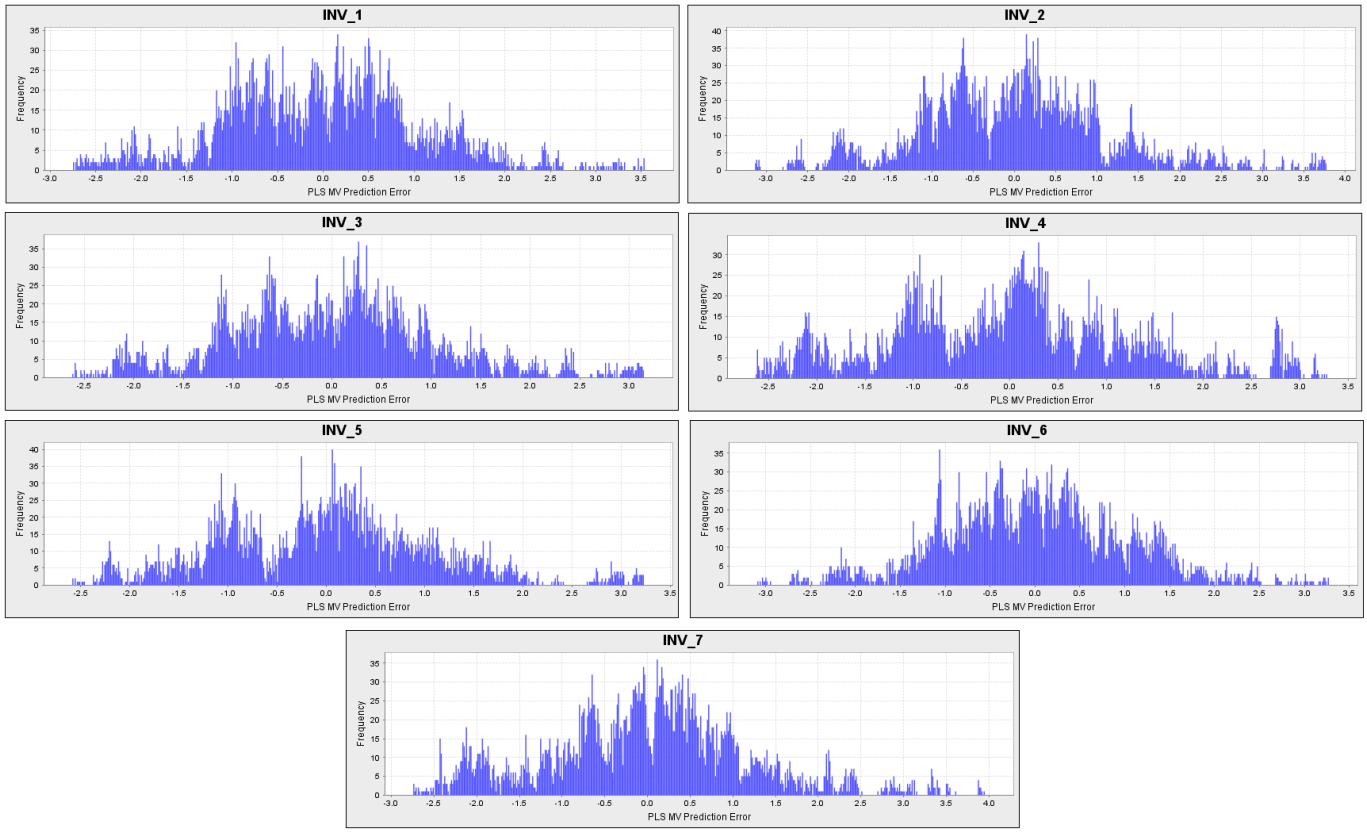

Figure 2. PLS-MV prediction errors for indicators of INV. Source: Authors'.

5. Discussion and Implications

The direct effect of overconfidence on investment decision-making is significant and consistent with the previous literature (Chen et al. 2007). When investors are overconfident, they indulge in excessive trading activities (Evans 2006). Overconfident investors overestimate their abilities, skills, and knowledge (Hvide 2002). Additionally, they underestimate the risk involved in an investment (Nofsinger 2001). Moreover, risk perception has been found to mediate the relationship between overconfidence and investment decision-making significantly, thereby accepting Hypothesis (H1). Overconfident investors rely more on their private information regarding the riskiness of a strategy (Chuang and Lee 2006). Therefore, they give less weightage to outside information and thus reduce their risk perception (Barnes 1984; Russo and Schoemaker 1992). Hence, an overconfident investor will tend to have a lower perception of risk (Barnes 1984; Russo and Schoemaker 1992; Nofsinger 2001) and will trade more aggressively.

The availability heuristic causes investors to rely upon readily available information, ignoring other alternatives and procedures (Folkes 1988). Individual investors trading in the stock market are also influenced by the information they receive during the selection

and identification of stocks (Haley and Stumpf 1989). Investors' preferences change as per the availability of information (Harris and Raviv 2005); thus, a particular leading pattern and irrelevant information also impact their decision-making. The direct effect of availability bias on investment decision-making is significant, in line with the results from previous literature (Haley and Stumpf 1989; Harris and Raviv 2005). Moreover, a mediation effect of risk perception is significant in the relationship between availability bias and investment decision-making, thereby accepting the Hypothesis (H2). A study of extant literature reveals that when more information is available to investors, their risk perception increases, resulting in less stock investment (Harris and Raviv 2005). Barbosa and Fayolle (2007) presented a different view about risk perception, stating that if investors perceive any stock-related information positively, it will reduce their risk perception and ultimately affect their investment decisions.

Representativeness bias changes the investors' risk perception, which further induces them to overreact and buy hot stocks rather than stocks that have performed poorly in the past (De Bondt and Thaler 1995). Xue and Zhang (2017) and Bezzina et al. (2014) elaborated that in times of uncertainty, when an investor faces inadequacy of information and time constraints, investors need help understanding the causes of past failure cases. In such a scenario, previous successful self-taken decisions become the reference for future decisions. The impact of representativeness bias on investment decisions is significant and similar to the previous literature (Hirshleifer 2001; Chen et al. 2007). Investors with representativeness bias consider a small sample representative of the entire population (Kim and Byun 2011) and tend to invest in stocks portraying abnormal returns in the past (Kumar and Dhar 2001). Moreover, risk perception has significantly mediated the relationship between representativeness and investment decision-making, thus accepting the Hypothesis (H3). When investors experience repetitive successful decision outcomes over a long period, it creates a positive opinion in their minds and, eventually, representativeness bias reduces the investors' risk perception (Xue and Zhang 2017).

Tversky and Kahneman (1974) asserted that the anchoring heuristic does not occur when the initial value is given; instead, it occurs when there is a lack of reliable information. Investors also estimate the earnings of the company based on past trends (Waweru et al. 2008). Investors with anchoring bias consider previous stock prices as the base for predicting the future price and take their decisions based on previous stock prices, known as anchors. They rely on one piece of information (viz. news, trading volumes, one-day returns) while taking investment decisions (Andersen 2010). The anchoring bias significantly affects investment decision-making, as per previous studies' results (Kengatharan and Navaneethakrishnan 2014). This refers to the strong inclination of the investors towards predicting the value based on the assumption of "initial value" or "default number" as a reference point (Pompian 2011; Shiller 1999). Moreover, risk perception has also significantly mediated the relationship between anchoring bias and investment decision-making, thereby accepting the Hypothesis (H4). Therefore, it can be concluded that anchoring bias changes the investors' risk perception (Tversky and Kahneman 1974) and, consequently, affects their investment decision-making (Keyes 1985; Bromiley and Curley 1992).

Daniel et al. (2002) described that the irony of gambler's fallacy is a flawed supposition considering that if a random event occurs more often than expected over a period, the same is less likely to appear in future. Investors having the presence of gamblers' fallacy bias generally carry a mistaken belief in their minds, believing that the trend will reverse. This is based on the notion that if a random event happens more often than predicted over a period, the same is less likely to occur in future (Daniel et al. 2002). A significant effect of gambler's fallacy bias on investment decision-making has been found in the study, and the same is akin to the extant literature (Hunjra et al. 2012). Moreover, risk perception has significantly mediated the relationship between gambler's fallacy and investment decision-making, thereby accepting the Hypothesis (H5). Therefore, it can be inferred that gambler's fallacy influences the investors' risk perception (Busenitz and Barney 1994) and consequently impacts the investors' decision-making.

It is evident from the above discussion that various behavioural biases change the risk perception of the investors, consequently impacting their decision-making. All the hypotheses of the study were supported, implying that risk perception plays a significant role as a mediator between behavioural biases and investment decision-making. The study's findings benefit the capital market participants and other stakeholders such as equity investors, policymakers, and financial advisors dealing in finance. Equity investors will come to know about the biases which are affecting their decision-making process. After gaining knowledge about behavioural biases and understanding the risk involved in equity investments, individual investors will be able to overcome these biases and make their decision-making more effective. Investors with an overconfident frame may trust their knowledge or instincts more, which outweighs their risk perception ability. However, they need to take precautionary measures while investing in the stock market to save themselves from huge losses. The policymakers can also use insights from the study to augment financial literacy, which will result in the financial wellbeing of the individual equity investors and the Indian economy as a whole. Financial advisors can also understand the decision-making process of equity investors more effectively, and they will be able to provide tailored financial services per the investors' specific needs.

6. Conclusions, Limitations, and Future Research Opportunities

The decision-making of investors is affected by many behavioural biases. As there are many uncertainties involved in the decision-making process, the risk is inherently involved in each decision which is perceived to be very less by the investor under the influence of biases. Hence, the results of this study provide valuable insight into the impact of behavioural biases (heuristics) on the investment decision-making behaviour of individual equity investors through the mediating role of risk perception. Investors should focus on overcoming these biases and give thought to the risk involved in the investment decision to avoid undesired losses.

The present research has been conducted on the sample size of 432 investors from the state of Punjab trading on the National Stock Exchange. Although the sample size is sufficient, it is still considered a limitation of the study. Future studies can expand the study and consider other North Indian regions. It has also been noticed that most of the existing studies have examined the impact of behavioural biases on equity investors' decision-making, deploying traditional statistical techniques such as covariance-based SEM and Partial Least Square Sem. Future studies may be conducted to predict the impact of behavioural biases on equity investors' decision-making by deploying machine learning based models such as recurrent neural networks (RNN) and artificial neural networks (ANN). Future studies can also consider hybrid and robust techniques such as the hybrid PLS-SEM-neural network approach (Mishra et al. 2023). As circadian rhythm has grabbed a lot of attention in the recent past (Lepone and Yang 2020), therefore future studies may be conducted by dividing the investors into morning traders (early birds) and evening traders (night owls).

Additionally, studies on financial advisors and stockbrokers may examine how behavioural biases impact their decision-making. Additionally, the study does not address if the same results prevail across different groups categorised based on gender, religion, culture, educational qualification, the purpose of investing, income status, etc. The future study can be extended by incorporating these variables.

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