

# Personality traits as predictor of cognitive biases: moderating role of risk-attitude

Moderating  
role of risk-  
attitude

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Received 13 October 2019  
Revised 4 April 2020  
Accepted 23 April 2020

## Abstract

**Purpose** – This study aims to examine that personality traits are associated with the investor's ability to exhibit disposition effect, herding behavior and overconfidence. It also explores how risk-attitude can modify investor behavior by moderating the association between personality traits, disposition effect, herding and overconfidence.

**Design/methodology/approach** – Data were collected from 396 respondents by using personally administrated survey. Confirmatory factor analysis (CFA) was used to confirm the validity and reliability of data. Regression analysis was used to test the proposed hypotheses.

**Findings** – The results supported the proposed hypotheses and showed that extravert investors were more likely to exhibit disposition effect, herding and overconfidence. The conscientiousness trait was associated with disposition effect and overconfidence, while neuroticism was associated with herding behavior. The results confirmed the moderating effect of risk aversion on the association between personality traits, disposition effect, herding and overconfidence.

**Originality/value** – This study demonstrates how risk aversion moderates the strength of association between psychological characteristics (represented by personality traits) and cognitive biases (disposition effect, herding and overconfidence). The results support the "auction" interpretation of investors' behavior by suggesting that personality traits are associated with investment decision-making and that investors are marginal price setters.

**Keywords** Personality traits, Biases, Risk-attitude, Auction interpretation

**Paper type** Research paper

## 1. Introduction

Behavioral finance assumes that investors' actions are driven by bounded rationality (Barberis and Thaler, 2003), and their decision-making is influenced by psychological, cognitive and emotional factors (Barberis and Thaler, 2003; Chaffai and Medhioub, 2014; Endler and Magnusson, 1976; Ricciardi, 2008). The human brain can hinder investment decisions (Shefrin and Statman, 2000), depending on the psychological characteristics of the investors (Durand *et al.*, 2008, 2013a, 2013b, 2019). The psychological factors can induce individuals to deviate from rational decision-making processes through an exhibition of cognitive biases, under conditions of risk and uncertainty (Baker and Wurgler, 2007; Kahneman and Tversky, 2013). Durand *et al.*, (2008, 2013b, 2019) and Lin (2011) argued that investors' psychological factors, that is, personality traits influence the likelihood of exhibiting cognitive biases during the investment decision process.

Frequently, investors face uncertain situations that can potentially result in losses or gains. Investors must quickly respond to such a situation either to prevent losses or take



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Qualitative Research in Financial  
Markets  
Vol. 12 No. 4, 2020  
pp. 465-484  
Emerald Publishing Limited  
1755-4179  
DOI 10.1108/QRFM-10-2019-0123

advantage of the opportunity. It is well established that risk-attitude shapes investor's decision-making process (Durand *et al.*, 2013a, 2013b; Lipe, 1998; Yang and Qiu, 2005). Risk-averse people may prefer choices with a low expected return than those who are risk-seekers. Extensive psychological evidence shows that individuals have limited cognitive capacity to process information and neglect complex cognitive processing that demands effort. In doing so, investors fail to update biased prior beliefs and follow the sub-optimal path of reasoning to make a decision that demands the least amount of cognitive processing. This decision is referred to as satisficing decision (Shefrin, 2007), and it leads to an exhibition of cognitive biases. Thus, one may inquire the factors that can induce investor's to engage in complex cognitive processing and subsequently reduce effect of cognitive biases on investment behavior. In particular, one such factor is the investor's level of risk-attitude. Evidence in economic behavior suggests that risk-attitude is strongly rooted in investor's personality and is represented by the big five personality traits (Bye and Lamvik, 2007; Engelberg and Sjöberg, 2007; Nicholson *et al.*, 2005). Pompian (2006) showed that individuals with impulsive personality traits are high risk-takers. Barnewall (1987) distinguished investors into active and passive and found that passive investors have low risk-aversion than active investors. Lerner and Keltner (2001) found that individuals with fear are more pessimistic and seek risk-averse choices. Hence, we can presume that the level of risk-attitude can modify investors' behavior by reducing the effect of cognitive biases.

Investors exhibit a number of cognitive biases during the decision-making process but three are most common among them i.e. overconfidence bias, herding behavior and disposition effect. Overconfident investors overweight their self-abilities, knowledge, experience and analytical skills and ignore non-confirming information (with prior beliefs). Acker and Duck (2008) and Barber and Odean (2001) show that men are more overconfident than women and subsequently experience significant losses. Under risk, investors follow market trends and try to replicate crowd behavior. This is due to investors' low self-confidence on their abilities and experience to process information. In doing so, they seek advice and try to follow others. Such behavior is attributed to herding bias. Investors mainly hold losing investments in anticipation of positive returns and dispose-off winning investments to realize an early profit. This effect is known as disposition effect and suggests that investors are impatient in realizing gains and reluctant to incur losses. Durand *et al.*, (2013b) provides that personality traits are associated with disposition effect and overconfidence. Furthermore, they support the "auction" interpretation of personality and investment - investors with particular personality traits are the marginal price setters of specific assets - as compared to "Dear Abby" interpretation - advisors are in a better position to provide advice to clients by knowing them better. Durand *et al.*, (2013b) further show that personality is at the core of understanding the investment decision process and helps in the development of coherent finance theory grounded in behavioral underpinnings. Nicholson *et al.*, (2005) show that personality profile is a significant predictor of risk-taking behavior and explains variations across individuals' behavior. Hence, individuals' risk-taking attitude can be linked to personality traits. Therefore, it is worth investigating how risk-taking attitude directly influences the likelihood of exhibiting biases and whether risk-taking attitude moderates the association between personality characteristics and cognitive biases.

The current study contributes to the economic behavior literature and demonstrates the influence of the level of risk-taking attitude on the association between personality traits and cognitive biases. Furthermore, it confirms that the level of risk-taking attitude strengthens individual involvement in the decision-making process to make an optimal financial decision. Finally, the study supports Durand *et al.*, (2008) "auction" interpretation by

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suggesting that personality traits influence the decision process and investors are marginal price setters.

The remainder of the paper is divided into five sections. Section 2 provides literature and hypothesis development, followed by a detailed discussion of data collection and method in the methodology in Section 3. Section 4 discusses the results. The alternative explanation of results based on the Types 1 and 2 decision-making process is presented in Section 5. Finally, Section 6 provides conclusions of the study and highlights the main limitations, while providing future research directions.

## 2. Literature and hypothesis development

Recent studies such as Durand *et al.*, (2008, 2013a, 2013b, 2019); Lin (2011), Lin and Lu (2015); Patterson and Daigler (2014) have focused on the effects of investor's personality traits on the investment decision-making process and exhibition of cognitive biases. They found a significant influence of investor's personality traits and risk-taking attitude on cognitive biases and investment decision process.

Gambetti and Giusberti (2012), Lin (2011); Statman *et al.*, (2006), Stone *et al.*, (2001) provide that investors with neuroticism trait lack confidence in their decision-making ability because they are emotionally unstable and nervous (Costa and McCrae, 1992). Investors characterized by the neuroticism trait are nervous and anxious, and want to realize early profit while holding losing stocks for a longer period of time (Lin, 2011; Wolfe and Grosch, 1990). They hence exhibit a disposition effect. Because of low levels of self-confidence, such investors also follow the advice and instructions of advisors and friends to make investment decisions, leading to herding behavior (Durand *et al.*, 2013a). Hence, it seems that the neuroticism trait in investors is negatively associated with overconfidence bias and positively linked with disposition effect and herding behavior.

The extraversion trait is characterized by zeal, energy, optimism, sociability, talkativeness and assertiveness (Costa and McCrae, 1992). Extraverts are optimistic about the expected performance of losing investment choices and retain them for a longer period (Van de Venter and Michayluk, 2008). Because of the sociability effect, they want to realize the short-term profits to reflect that they have earned a positive return and have used profitable strategies, leading to the disposition effect. Thus, there is a positive association between extraversion and disposition effect. Lin (2011) and Van de Venter and Michayluk (2008) found a positive impact of extraversion on overconfidence. The extraverts are optimistic in nature and overreact to market information, subsequently leading to biased decision-making. Similarly, investors who are extraverts are talkative and exchange views with others on different aspects of investment alternatives and strategies. Such individual give more weight other people's advice than their own, resulting in herding behavior. Hence, the extraversion trait is positively associated with disposition effect, herding effect and overconfidence.

Openness refers to active imagination, intellectual curiosity and aesthetic sensitivity (Costa and McCrae, 1992). Due to intellectual curiosity, investors are more open to updated information on investment alternatives. Such investors are prone to follow the suggestions of friends, peers and advisors and frequently update portfolios. Thereby, investors reflect both overconfidence and herding behavior (Lin, 2011). Investors with limited attention only consider prior beliefs confirming market information and neglect non-confirming market information to make investment decisions driven by beliefs, subsequently leading to herding behavior. The optimistic investors frequently trade in the market: they sell winning stocks to realize a profit but retain the losing investment choices and search for reasons that overcome the regret aversion from losses, resulting in disposition effect. Hence, openness

trait among investors is positively associated with disposition effect, herding behavior and overconfidence.

Modesty, altruism, corporation, helpfulness, personal warmth and sympathy are the prime characteristics of the agreeableness trait (Costa and McCrae, 1992). Agreeable investors rely on updated market information to make investment decisions. They also help others under the influence of overconfidence bias. They show personal warmth and sympathy to others and want to present a good self-image to others. Therefore, they sell out winning stocks to realize gains and hold on to losing investments to reflect a successful image to others. Hence, the agreeableness trait positively influences individuals' exhibition of the disposition effect, herding behavior and overconfidence (Durand *et al.*, 2013b).

Individuals with the conscientiousness trait are strong-willed, determined, organized, punctual and purposeful (Costa and McCrae, 1992). They do not rely on others and consider their own knowledge and decision-making abilities important. Such individuals have confidence in their abilities and pay less attention to other people's advice when making investment decisions. Conscientious investors are less prone to exhibiting herding behavior because they rely on their own knowledge and information. They take less informed investment decisions by selling the winning stocks early and holding losing stocks (disposition effect). Thus, conscientiousness is negatively associated with the herding behavior and positively with disposition effect and overconfidence (Durand *et al.*, 2013b). Hence, the overall baseline assumption is

*H1.* Personality traits have a significant impact on investors' ability to exhibit disposition effect, herding behavior and overconfidence.

Risk-taking attitude refers to the risk-taking propensity of the individuals to either engage in or avoid making risky choices (Harnett and Cummings, 1980; Kogan and Wallach, 1967; Sitkin and Pablo, 1992). Existing studies suggest that personality traits provide insight into the level of risk tolerance (Pompian, 2006). For instance, the Bailard, Biehl and Kaiser (BB and K) model classifies individuals into five categories based on differences across the level of risk-taking attitude (Bailard *et al.*, 1986). Barnewall (1987) classified investors as passive and active. Passive investors are more risk averse and seek to invest in secure investment choices; however, active investors are more risk seekers and seek risky choices that promise high returns. However, Pompian (2006) shows that investors with impetuous traits have a higher propensity to take risks. Borghans *et al.*, (2009) claim that differences in risk evaluation and ambiguity are associated with personality traits and cognitive characteristics. They find that women are more risk averse and deal with ambiguity by making low-risk choices as compared to men, but as the level of ambiguity increases both respond similar to the marginal change in ambiguity. Benartzi and Thaler (1995) find that the emotions of the investor affect decisions pertaining to financial decision-making and portfolio revision of the investor. Evidence shows that investors take low financial risk under consistent feedback.

Kuhnen and Knutson (2011) provide that investors with positive emotions like excitement are more confident and seek high-risk investment choices. However, investors with negative emotions are more anxious and prefer to invest in low-risk choices. Similarly, Lerner and Keltner (2001) find a conflicting effect of fear and anger on risk perception. Fearful individuals are more pessimistic and opt for risk-averse choices, whereas, an angry individual is more optimistic and seeks high-risk choices. Moreover, risk taking patterns of angry individuals closely resemble those of the happy individual as compared to the fearful individuals. Considering the mood of investors, Kaplanski *et al.*, (2015) show that noneconomic factors have a significant influence in shaping risk and return expectations of investors. Specifically, they find that good mood and favorite sports results have a positive influence on individual's return expectations, whereas investors suffering from seasonal

affective disorders have expectations signifying low returns in autumn than in other seasons. [Nicholson et al., \(2005\)](#) suggest that personality profile provides an explanation for individual risk-taking behavior and the influence of differences in personality profiles on the same. They present that risk propensity is dependent on age, gender, career-related risk objectives and strongly rooted in the individual personality. Specifically, findings supports that risk propensity is associated with a high level of openness and extraversion, and a low level of agreeableness, neuroticism and conscientiousness. Hence, individual risk-taking attitude varies across personality traits ([Nicholson et al., 2005](#)). Different personality traits may induce a different level of risk-taking attitude for different investors that may influence the investment decision-making process ([Nicholson et al., 2005](#)). Thus, one can presume that the level of risk-taking attitude moderates the association between personality traits and biases. Therefore:

*H2.* Risk-taking attitude moderates the association between personality traits, disposition effect, herding behavior and overconfidence.

### 3. Methodology

This section is subdivided into three subsections. Subsection 1 elaborates on the constructs used to measure personality traits, risk-taking attitude and cognitive biases. Subsection 2 provides an explanation of the data collection process and highlights a few characteristics of the sample. Finally, Subsection 3 highlights methods used to check the reliability, and validity of data.

#### 3.1 Research constructs

Many studies have proposed different facets to measuring individual personality, among which the most common are internal and external personality factors ([Rotter, 1966](#)), BB and K model of personality types ([Bailard et al., 1986](#)), Myers-Briggs type personality indicators ([Myers et al., 1985](#)) and big five personality traits ([Costa and McCrae, 1992](#)). The current study adopts the big five personality model to investigate the impact of personality traits on disposition effect, herding behavior and overconfidence. The big five personality model consists of openness, extraversion, conscientiousness, agreeableness and neuroticism traits. [Costa and McCrae \(1992\)](#) developed a 60-items NEO Five Factor Inventory (NEO-FFI), which uses 12-items to measure each personality trait. The current study used a revised 23-items NEO-FFI shortened measurement for the big five personality model. The scale used a five-point Likert scale starting from strongly disagree to strongly agree (i.e. strongly agree, agree, neutral, disagree and strongly disagree). The high score of neuroticism represents a high level of anxiety, tenseness, insecurity and moodiness ([Costa and McCrae, 1992](#)). The high score of extraversion indicates a high level of optimism, assertiveness, talkativeness, sociability and energy ([Costa and McCrae, 1992](#)). The high score of openness refers to high levels of intellectual curiosity, active imagination, broad cultural interest, preference for variety and aesthetic sensitivity ([Costa and McCrae, 1992](#)). The agreeableness high score indicates the investor's tendency to depict high altruism, sympathy, cooperation, personal warmth and helpfulness toward others ([Costa and McCrae, 1992](#)). Finally, investors with a high score in conscientiousness reflect a high amount of purposefulness, punctuality, determination, reliability, organization and strong willpower ([Costa and McCrae, 1992](#)).

For risk-attitude, a scale developed by [Gomez-Mejia and Balkin \(1989\)](#) was used. This scale is based on the work of Slovic, and consists of four items with a five-point Likert scale. The scale is revised by [Mayfield et al., \(2008\)](#) to suit the specific reference of behavioral and

personal finance. The individual with a high risk-taking attitude score represents an individual who avoids risk and one with a low score is considered to be a risk seeker.

The scales for the disposition effect, herding behavior and overconfidence were based on the measurements provided by Devenow and Welch (1996), Lin (2011), Scharfstein and Stein (1990), Shefrin and Statman (1985, 1994), Sias (2004), Statman *et al.*, (2006). Each item is measured with a five-point Likert-scale starting from strongly disagree to strongly agree.

### 3.2 Data collection

The data was collected from undergraduate and post-graduate students from two universities in Peshawar, Pakistan. A total of 405 students participated in the exercise and 396 questionnaires were used in the analysis, 9 questionnaires were rejected because of missing responses. To ensure that students take the exercise seriously, the survey was administered as part of a class assignment. Each student on completion of the survey was given one bonus mark in the final performance evaluation in the course [1].

The data were representative, with no selection bias because data were collected from students of different degree levels (i.e. graduate and post-graduate), different academic programs (i.e. business administration, computer science and telecommunication), different age groups and a different status of students (i.e. full-time students, part-time students and professionals). There was also demographic heterogeneity in the collected data, overcoming the problem of geographical closeness. Moreover, there was no built-in sample design bias because 260 out of 396 respondents have investment knowledge, 345 have investment experience and most importantly 345 are current investment holders. This suggests that respondents made a representative sample for the study.

### 3.3 Data analysis

The data were analyzed using two steps. First, overall measurement quality was assessed by testing the reliability and validity of instruments via confirmatory factor analysis (CFA). Secondly, cross-sectional regression was used to examine the impact of personality traits, risk-taking attitude and interaction terms on disposition effect, herding behavior and overconfidence.

$$BB_i = \beta_0 + \beta_1 N_i + \beta_2 E_i + \beta_3 O_i + \beta_4 A_i + \beta_5 C_i + \beta_6 R_i + \beta_7 Ag_i + \beta_8 G_i + \beta_9 N_i * R_i + \beta_{10} E_i * R_i + \beta_{11} O_i * R_i + \beta_{12} A_i * R_i + \beta_{13} C_i * R_i + \mu_i \quad (1)$$

In equation (1) “BB” represents three biases (i.e. disposition effect, herding behavior and overconfidence), “N” is neuroticism, “E” is extraversion, “O” is openness, “A” is agreeableness, “C” is conscientiousness, “R” is risk-attitude, “Ag” is age, “G” is gender and interaction terms of risk-attitude and personality traits shows the moderating impact of risk-attitude on the association between personality traits and biases.

CFA was used to assess the reliability and validity of items. Each latent variable was measured with the help of either six, five, four or two observed variables. Composite reliability (CR) was used to check the measurement reliability of each construct. A CR value greater than 0.7 is acceptable (Malhotra and Dash, 2011). The validity of the measures was checked through convergent validity and discriminant validity. To check convergent validity average variance extracted (AVE) was used. For AVE, the threshold value should be greater than 0.5 (Malhotra and Dash, 2011). To obtain discriminant validity the square root of AVE should be greater than inter-construct correlation (Malhotra and Dash, 2011).



The CFA model fitness was tested with the help of  $\chi^2/df$ , comparative fit index (CFI), residual mean squared error of approximation (RMSEA) and standardized root mean square residual (SRMR). There is no consensus on the threshold value for  $\chi^2/df$ , acceptable values range from two (lowest) to the as high as five (Hu and Bentler, 1999; Wheaton *et al.*, 1977). The threshold value for CFI is in the range of 0 to 1.0, a value closer to 1.0 represents a good model fit. The RMSEA value for a good model fit is closer to 0 with an upper limit to 0.8 (MacCallum *et al.*, 1996). SRMR value ranges from 0 to 1.0, a good model fit has a value lower than 0.5 (Byrne, 1998; Diamantopoulos *et al.*, 2000). The value closer to zero indicate a perfect model fit.

After confirming the validity and reliability of instruments, cross-sectional regression analysis was used to test the hypotheses. The moderating role of risk-taking attitude was captured through interaction terms of risk-taking attitude and personality traits. In Model 1 coefficient terms (i.e.  $\beta$ s) 9 to 13 capture the interaction effect.

#### 4. Results and analysis

This section is divided into three subsections. Subsection 1 provides details on sample characteristics. Subsection 2 provides an explanation of the measurement model used to confirm the validity and reliability of measurement constructs. The final subsection provides a detailed discussion of empirical results.

##### 4.1 Sample characteristics

Table 1 provides sample characteristics. Among the 396 respondents, 272 and 124 were female accounted for 68.69% and 31.31% of total responses, respectively. The age of respondents varied from 19 to 41 years. The age group of 20-25 years old constituted 52.02% of the total responses. The second main age segment was that of 26-30 years old, constituting 21.72% of the total responses. Important characteristics of respondents were their investment knowledge, investment experience and investment holdings. Investment knowledge represented investment analysis courses taken at the graduate or post-graduate level as part of the program coursework; 65.66% of the students have studied the investment analysis course. In total, 325 respondents had investment experience and 345

Variable	Characteristics	Frequency	Age of sample (%)	Cumulative (%)
Gender	Male	272	68.69	68.69
	Female	124	31.31	100.00
Age	<20 years	60	15.15	15.15
	20-25 years	206	52.02	67.17
	26-30 years	86	21.72	88.89
	31-35 years	36	9.09	97.98
	>36 years	8	2.02	100.00
Investment knowledge	Have investment knowledge	260	65.66	65.66
	No investment knowledge	136	34.34	100.00
Investment experience	Yes	325	82.07	82.07
	No	71	17.93	100.00
Current investment	Yes	345	87.12	87.12
	No	51	12.88	100.00

Source: Author calculations

**Table 1.**  
Sample  
characteristics

respondents had current investments. Investment here refers to the purchase of stocks, bonds and real estate property with the objective of future positive return. The investment experience and current investment of respondents represent their own personal investment or investment on behalf of the family, for a profitable purpose. Hence, a significant number of respondents had investment knowledge and experience. The information provided by respondents suggests that most of them were real-time investors.

#### 4.2 The measurement models

The first step in CFA is to assess the validity of observed variables through standard loading and significance. Table 2 shows that standard loading for observed variables is greater than 0.6 and highly significant with  $p$ -value  $\leq 0.001$ , suggesting that all the observed variables significantly explain the latent variables. The model fitness was checked with the help of  $\chi^2/df$ , which is 5.4145, slightly higher than the acceptable value of 5. To further confirm the model fitness, measures such as RMSEA, CFI, TFI and SRMR were used. The RMSEA is the most commonly used test for model fit and the value for RMSEA is 0.106 ( $p$ -value  $\leq 0.001$ ), which is closer to zero and represented the best model fit. The value for CFI is 0.664 and is under acceptable range, represents a good model fit. The threshold value for SRMR less than 0.08 provides a good model fit. The results in Table 2 provide the SRMR value of 0.078, representing a good model fit. Similarly, the value of CFI is 0.664 and TLI is 0.623 that falls under acceptable range and suggests the good model fit. Thus, observed variables significantly explain the latent variables and model is a good fit. The CR values of latent variables range from 0.75 to 0.86, which is, greater than the threshold value of 0.7, confirming the reliability of the measures.

Construct validity is determined by using convergent and discriminant validity. Table 2 suggests that AVE values for all the constructs are greater than the threshold value of 0.5, confirming the convergent validity of all the constructs. The highest inter-construct correlation is between agreeableness and conscientiousness i.e. 0.3946883. The square root AVE of all constructs is greater than 0.3946883, confirming the discriminant validity of the constructs.

#### 4.3 Empirical results

The empirical results are divided into three subsections. The following three subsections discuss the impact of personality traits, risk-attitude, interaction terms on disposition effect, herding behavior and overconfidence.

**4.3.1 Disposition effect.** Table 4 provides the results of the role of personality traits, risk-attitude and interaction terms in explaining the disposition effect. The results suggest that extraversion, conscientiousness and risk-taking attitude play a significant role in explaining investor tendency to exhibit disposition effect. Extraversion was found to be positively associated with disposition effect with  $p$ -value  $\leq 0.05$  and a coefficient value of 0.3107309. This shows that energetic, optimistic and social investors are self-confident, want to realize early profits and retain their losses to reflect that they have used an effective investment strategy by properly analyzing the available market information and using investment experience (Van de Venter and Michayluk, 2008). Investors reflecting a higher level of optimism, sociability and assertiveness are more likely to exhibit disposition effect and realize early profit (Durand *et al.*, 2013a). Results provide a significant and positive influence of conscientiousness ( $p$ -value  $\leq 0.05$ ) on disposition effect with a coefficient value of 0.3718812, suggesting that strong-willed, organized and purposeful investors regard their own knowledge, expertise and experience for making investment decisions. In doing so, investors neglect updated market information and accumulate risky investments in their



Constructs/scale items	Standardized loading	Standard errors	z-values	p-value	95% confidence interval	Composite reliability index	Average variance extracted
<i>Neuroticism</i>							
N1	0.6655375	0.0328623	20.25	0.000	0.6011286	0.861367401	0.554856848
N2	0.7735405	0.0261222	29.61	0.000	0.722342		
N3	0.7413925	0.0279484	26.53	0.000	0.6866146		
N4	0.7784194	0.0260789	29.85	0.000	0.7273057		
N5	0.759855	0.0270894	28.05	0.000	0.7067606		
<i>Extraversion</i>							
E1	0.825679	0.0267382	30.88	0.000	0.7732732	0.82910854	0.549626276
E2	0.6643218	0.0360702	18.42	0.000	0.5936256		
E3	0.7451145	0.0293858	25.36	0.000	0.6875194		
E4	0.7212768	0.0316118	22.82	0.000	0.6593188		
<i>Openness</i>							
O1	0.7191526	0.0303967	23.66	0.000	0.6595762	0.837633431	0.508767768
O2	0.7247441	0.0301136	24.07	0.000	0.6657225		
O3	0.6358301	0.0353734	17.97	0.000	0.5664995		
O4	0.7080217	0.031154	22.73	0.000	0.646961		
O5	0.7719001	0.0274482	28.12	0.000	0.7181026		
<i>Agreeableness</i>							
A1	0.7541789	0.030042	25.1	0.000	0.6952977	0.80066448	0.506136194
A2	0.5293888	0.0419989	12.6	0.000	0.4470724		
A3	0.767434	0.0298008	25.75	0.000	0.7090256		
A4	0.7658665	0.029633	25.85	0.000	0.707787		
<i>Conscientiousness</i>							
C1	0.8904674	0.0201039	44.29	0.000	0.8510646	0.832139803	0.503658386
C2	0.6823552	0.030921	22.07	0.000	0.621751		
C3	0.6079878	0.0361869	16.8	0.000	0.5370628		
C4	0.7341637	0.0278265	26.38	0.000	0.6796247		
C5	0.5925416	0.038284	15.48	0.000	0.5175064		
<i>Risk aversion</i>							
R1	0.6974587	0.0327226	21.31	0.000	0.6333235	0.817679725	0.529220088
R2	0.7045168	0.03219	21.89	0.000	0.6414256		

(continued)

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**Table 2.**  
Constructs items reliability and validity

Table 2.

Constructs/scale items	Standardized loading	Standard errors	z-values	p-value	95% confidence interval	Composite reliability index	Average variance extracted
R3	0.7899325	0.0273589	28.87	0.000	0.7363101	0.8435549	
R4	0.714209	0.0319179	22.38	0.000	0.651651	0.7767669	
<i>Overconfidence</i>						0.812957723	0.522714859
OC1	0.8148886	0.0287545	28.34	0.000	0.7585307	0.8712465	
OC2	0.6597232	0.0351876	18.75	0.000	0.5907568	0.7286896	
OC3	0.6631253	0.0347549	19.08	0.000	0.5950069	0.7312436	
OC4	0.7428635	0.0318487	23.32	0.000	0.6804411	0.8052859	
<i>Disposition Effect</i>						0.75725689	0.611804903
D1	0.6987569	0.0486622	14.36	0.000	0.6033808	0.7941329	
D2	0.8575247	0.0524144	16.36	0.000	0.7547944	0.960255	
<i>Herding</i>						0.807096849	0.513217599
H1	0.6451263	0.0361096	17.87	0.000	0.5743528	0.7158997	
H2	0.7118212	0.032304	22.04	0.000	0.6485066	0.7751358	
H3	0.8159131	0.0276512	29.51	0.000	0.7617177	0.8701085	
H4	0.6813801	0.0343134	19.86	0.000	0.6141271	0.7486331	

Source: Author calculations

portfolio by selling winning and retaining losing investments. Investors with conscientiousness trait often overlook their weaknesses and emphasize their strengths.

Risk-taking attitude shows a highly significant effect on disposition effect with a  $p$ -value  $\leq 0.001$  and a positive coefficient value of 1.325623. This suggests that risk-averse investors realize small profits to avoid the risk of loss in anticipation of higher profits. In doing so, they are willing to retain the losing investments to avoid the regret of loss (regret aversion), resulting in magnifying the riskiness of the investment portfolio (Statman, 2011).

The results also show a significant moderating effect of risk-taking attitude on the association between extraversion, agreeableness and disposition effect. The interaction term of extraversion and risk-taking attitude provide a negative significant effect on disposition effect with a  $p$ -value  $\leq 0.05$  and the coefficient value of  $-0.1059249$ . This suggests that the increase in the level of extroversion in risk-averse investors reduces their tendency to exhibit disposition effect. Investors with high optimism, self-confidence and socialism invest with an objective to reduce portfolio risk. They are more careful in analyzing updated market information and are less likely to increase the portfolio risk by retaining losing and selling winning investments. They carefully examine alternatives to earn profits by maintaining the low portfolio risk and use a strategy that can provide profit under low risk. Figure 1 shows that risk-averse investors with a higher level of extraversion have a lower tendency to exhibit disposition effect. As the level of extroversion increases, risk-averse investors act more carefully while making investment decisions to reduce the amount of risk in the portfolio. In contrast, risk-takers with a high level of extraversion are more likely to exhibit disposition effect, suggesting that the increase in the level of extroversion in risk-seekers increases the probability of exhibiting disposition effect. Thus, individuals with a high level of extraversion can reduce investor's tendency to exhibit disposition behavior.

The results also present a significant moderating effect of risk-taking attitude on the association between agreeableness and disposition effect, that is, a negative coefficient value of interaction term  $-0.1116947$  with a  $p$ -value  $\leq 0.05$ . This suggests that risk-averse investors with a high level of agreeableness are less likely to exhibit disposition effect. Investors with personal warmth, sympathy and helpfulness act as a mentor to others and try to make systematic investment decisions. They understand that their decisions can influence their social status, therefore, they are more likely to devise a strategy that can provide profit and keep portfolio risk at a lower level. Figure 2 confirms this finding by suggesting that risk-averse individuals with a higher degree of agreeableness have a lower probability to exhibit disposition effect because of the careful selection, evaluation and revision of portfolio due to the mentoring and advising roles taken on by the investors. To communicate an efficient and effective picture of their investments, investors with a high level of agreeableness under high risk-taking attitude are more cautious in portfolio

Model fit test	Value
$\chi^2$ (593)	3,211.38 (0.000)
$\chi^2/df$	5.4154
RMSEA	0.106 (0.000)
CFI	0.664
TLI	0.623
SRMR	0.078

Source: Author calculations

**Table 3.**  
Model fit test

	Disposition effect	Herding effect	Overconfidence
Neuroticism	0.1408149 (0.1920807) {0.73}	0.5880451** (0.2192481) {2.68}	0.2269801 (0.2155441) {1.05}
Extraversion	0.3107309* (0.1540745) {2.02}	0.4111794* (0.1635293) {2.52}	0.5216593* (0.2273734) {-2.29}
Openness	0.0601973 (0.2204067) {0.27}	-0.1342413 (0.2184481) {-0.61}	-0.3457975 (0.2432469) {-1.42}
Agreeableness	0.3273088 (0.1817936) {1.80}	-0.1492716 (0.1947369) {-0.77}	-0.2535591 (0.283171) {-0.90}
Conscientiousness	0.3718812* (0.1689111) {2.20}	-0.2141922 (0.2003472) {-1.07}	0.8048288*** (0.2501412) {3.22}
Risk aversion	1.325623*** (0.3445066) {3.85}	-0.6118976 (0.3586412) {-1.71}	0.2560682 (0.4311584) {0.59}
Neuroticism* risk aversion	-0.0281962 (0.0536044) {-0.53}	0.1869832** (0.0614498) {3.04}	-0.1042727 (0.061673) {-1.69}
Extraversion * risk aversion	-0.1059249* (0.0432415) {-2.45}	-0.0867484 (0.0470394) {-1.84}	0.1209719 (0.0698586) {1.73}
Openness * risk aversion	-0.0080916 (0.0701112) {-0.12}	0.0191381 (0.0651106) {0.29}	0.0722474 (0.0757928) {0.95}
Agreeableness * risk aversion	-0.1116947* (0.0521863) {-2.14}	0.0701018 (0.053805) {1.30}	0.1011147 (0.0793883) {1.27}
Conscientiousness * risk aversion	-0.0492156 (0.0503331) {-0.98}	0.0582205 (0.0541037) {1.08}	-0.261398*** (0.0675516) {-3.87}
Gender	0.3020427*** (0.0903297) {3.34}	0.2759598** (0.1030224) {2.68}	0.2668808* (0.1114851) {2.39}
Age	-0.0305051*** (0.0089395) {-3.41}	-0.0012038 (0.0092735) {-0.13}	-0.0171518 (0.0114799) {-1.49}
Constant	-1.132542 (1.131957) {-1.00}	4.662364*** (1.232537) {3.78}	3.725881 (1.459116) {2.55}
$R^2$	0.228	0.1306	0.1001
$F$ -statistics ( $p$ -value)	15.41 (0.000)	7.16 (0.000)	4.71 (0.000)
Root MSE	0.69831	0.77609	0.87791

**Table 4.**  
Regression results

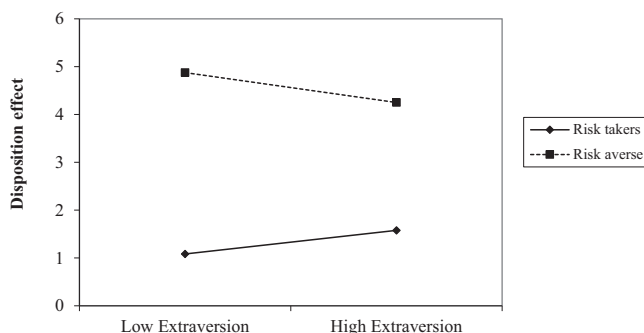
**Notes:** Where \* $p \leq 0.05$ ; \*\* $p \leq 0.01$ ; \*\*\* $p \leq 0.001$ ; () provides standard error; {} provides  $t$ -statistics  
**Source:** Author calculations

selection and revision, reducing the chances of retaining losing investments in the portfolio. However, risk-takers with a high level of agreeableness are most likely to exhibit disposition effect. It suggests that risk-takers may ignore the updated market information and can take the misinformed investment decision by selling winning and retaining losing risky

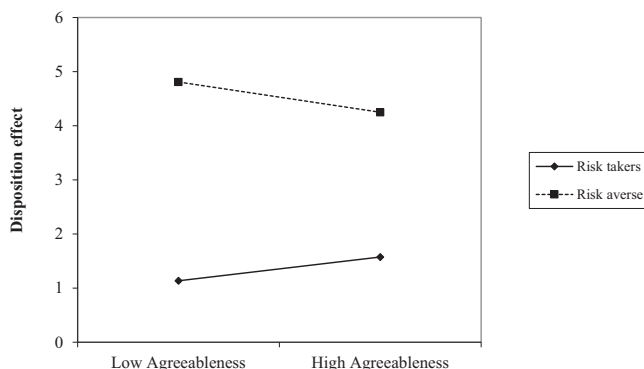
investments. Hence, individuals with a high level of agreeableness are less likely to exhibit disposition behavior.

The results confirm that disposition effect is the function of extraversion, conscientiousness and risk-attitude. These personality traits drive investor behavior and the investors having these specific personality traits are the marginal price setters. These results favor the “auction” interpretation of the Durand *et al.*, (2008). Similarly, risk-taking attitude moderates the association between extraversion, agreeableness and disposition effect, which further confirms that personality traits modify the investor’s behavior.

**4.3.2 Herding effect.** Table 4 provides the role of personality traits, risk-taking attitude and interaction terms in explaining herding behavior. The results show that neuroticism and extraversion have a significant influence in determining herding behavior. Results show a significant positive effect of neuroticism on herding behavior with a coefficient value of 0.5880451 and  $p$ -value  $\leq 0.01$ . This suggests that investors’ negative emotions induce moodiness and lack of confidence that leads to unstable and nervous decisions (Lin, 2011; Wolfe and Grosch, 1990). To overcome the consequences of uninformed decisions due to negative emotions (like regret aversion), investors seek professional advice to take financial decisions (Durand *et al.*, 2013a). Thus, negative emotions strongly correspond to herding behavior. Extraversion was found to be positively associated with herding behavior with a coefficient value of 0.411794 and a  $p$ -value  $\leq 0.05$ . This shows that social, extrovert and outgoing investors follow the advice and investment patterns of other investors. The



**Figure 1.**  
Moderating effect of risk-attitude on the association between extraversion and disposition effect



**Figure 2.**  
Moderating effect of risk-attitude on the association between agreeableness and disposition effect

extrovert investor is more confident but weighs the advice of peers and advisors more highly than his own.

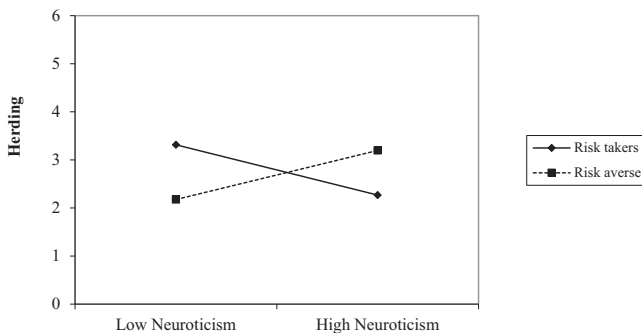
The results show a significant moderating effect of risk-taking attitude on the association between neuroticism and herding behavior. The results provide a significant positive value of interaction term coefficient i.e. 0.1869832 with  $p$ -value  $\leq 0.01$ , showing that risk-averse investors with a high level of negative emotions are more likely to exhibit herding behavior. Risk-averse investors with anxious, insecurity and tension are more prone to following the advice and trading patterns of the market (Durand *et al.*, 2013a). Such investors have no confidence in their own knowledge and abilities. They lose their confidence in cognitively intense situations and they rely on the advice of peers and professionals. Figure 3 confirms that risk-averse investors with a higher level of neuroticism have a higher tendency to exhibit herding behavior due to lack of confidence and cautious behavior toward investment decisions. In contrast, risk-takers with a high level of neuroticism are less prone to exhibiting herding behavior.

Hence, neuroticism and extraversion explain the investor's ability to exhibit herding behavior. Furthermore, the moderating role of risk-taking attitude to inhibit herding behavior supports the "auction" interpretation of Durand *et al.*, (2008) and shows that personality traits influence herding behavior.

**4.3.3 Overconfidence.** The results in Table 4 show a significant effect of extraversion and conscientiousness on individual's overconfidence. Results show a significant positive effect of extraversion on overconfidence with a coefficient value of 0.5216593 and a  $p$ -value  $\leq 0.05$ , suggesting that extrovert investors are more optimistic and retain losing investments in anticipation of abnormal returns (Van de Venter and Michayluk, 2008). This increase in portfolio risk and investor sell a profitable investment to realize smaller gains. Additionally, extroverts maintain prior beliefs and neglect updated market information, subsequently increasing portfolio riskiness.

Conscientiousness shows a significant positive impact on overconfidence with a coefficient value of 0.8048288 and  $p$ -value  $\leq 0.001$ . This suggests that conscientious investors are more confident and rely on their own abilities to make investment decisions. They pay less attention to updated market information and maintain prior biased beliefs (Durand *et al.*, 2013b).

The results present a significant moderating effect of risk-taking attitude on the association between conscientiousness and overconfidence. Risk-taking attitude negatively moderates the association with the coefficient value of  $-0.261398$  and a  $p$ -value  $\leq 0.001$ . This shows that risk-averse individuals with a high level of conscientiousness systematically select investment choices that reduce portfolio riskiness. Such investors



**Figure 3.**  
Moderating effect of risk-attitude on the association between neuroticism and herding and overconfidence



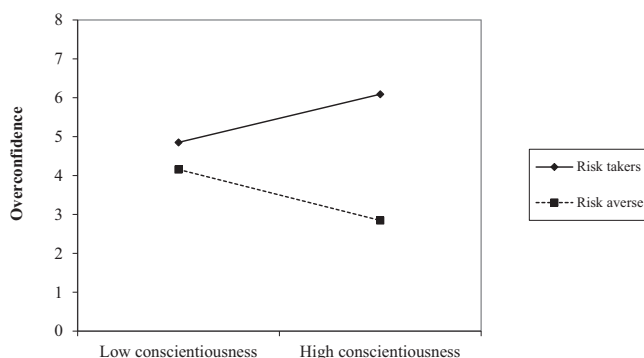
channel scarce cognitive resources toward the selection of low-risk investments. Hence, they suppress overconfident behavior and ensure decisions that decrease the riskiness of the portfolio 1. Figure 4 also confirms this finding by suggesting that risk-averse investors with a higher degree of conscientiousness have a lower tendency to exhibit overconfident behavior than risk-takers that exhibit a higher probability to exhibit overconfidence at a high level of conscientiousness. This shows that the investor's risk-taking attitude directs the application of cognitive resources to updated market information by reducing the influence of overconfidence on self-abilities and biased prior beliefs.

Hence, extraversion and conscientiousness explain investor's overconfident behavior and the moderating effect of risk-attitude favors the "auction" interpretation than "Dear Abby" interpretation of Durand *et al.*, (2008). This suggests that overconfidence is the function of extraversion and conscientiousness as well as investor behavior under the influence of personality traits. Hence, these results confirm the assumption of Durand *et al.*, (2008) that "personality is the main driver of individual investor behavior."

## 5. Alternative explanation

The alternative explanation of results can be provided by using the investor decision-making process to explain. The literature on decision-making provides two distinct mechanisms that require different levels of cognitive resources: one is intuition-based decision-making and the second is cognition-based decision-making. The first Type is termed as Type 1 and second as Type 2 (Stanovich and West, 2000). Type 1 is "largely unconscious, automatic and requires no computational capability" and referred to as a heuristic processing approach. However, Type 2 is more conscious and demands sufficient computational capabilities and is referred to as a systematic approach to decision-making (Stanovich and West, 2000).

The two types of cognitive mechanisms can be used to provide an alternative explanation for the determined results. The significant positive impact of extraversion, conscientiousness on disposition effect suggest that extravert and conscientious people are energetic, optimistic, self-confident (in terms of knowledge, expertise and experience) and strong-willed. These people rely more on decision-making short-cuts (i.e. heuristics) and ignore non-confirming updated market information. They hence make decisions based on biased prior beliefs, resulting in selling winning stocks and retaining losing stocks. Similarly, the effect of risk-taking attitude on the association between extraversion, agreeableness and disposition effect suggests that risk-averse investors at a higher level of extraversion and agreeableness are more careful in evaluating available information



**Figure 4.**  
Moderating effect of  
risk-attitude on the  
association between  
conscientiousness

(i.e. follow cognition-based decision-making) to reduce portfolio risk and strengthen successful mentoring and advice-giver roles. However, risk-takers possessing higher levels of extraversion and agreeableness are more prone to exhibiting disposition effect because they ignore the updated market information and use heuristics (i.e. follow intuition-based decision-making) based on prior experience, leading to sub-optimal investment strategy (Shefrin, 2007).

The results suggest a significant positive impact of neuroticism and extraversion on herding behavior. This suggests that individuals with negative emotions have low confidence in their knowledge, computational and cognitive abilities, and therefore, follow external advice and market patterns (herding behavior) to make investment decisions (i.e. follow intuition-based decision-making). Furthermore, results provide a positive moderating effect of risk-taking attitude on the association between neuroticism and herding behavior. This suggests that risk-averse investors with a high level of neuroticism are anxious with negative emotions and do not follow the systematic decision-making process. They rather look for market trends, family, friends and professional advice to make financial decisions (i.e. follow intuition-base decision-making).

Finally, results provide a significant positive effect of extraversion and conscientiousness on overconfidence. This suggests that strong-willed, social and optimistic investors are self-confident and rely on prior experience to avoid updated market information (Pompian, 2006). They hence follow a heuristic decision-making approach. Results also provide the negative moderating effect of risk-taking attitude on the association between conscientiousness and overconfidence. This suggests that risk-averse investors with a high level of conscientiousness follow a systematic decision-making process to avoid overconfident behavior. However, risk-takers with a high level of conscientiousness act overconfident and make an investment decision without following a systematic decision-making process.

Thus, it can be argued that the difference in investment decision-making behavior is attributed to personality traits and level of risk-attitude. The risk-averse individuals follow a systematic decision-making process than risk-takers that use a heuristic approach (Graham and Dodd, 2008; Shefrin, 2007). This also confirms the “auction” interpretation of Durand *et al.*, (2008) by suggesting that personality characteristics determine investor behavior and can be referred to as marginal price setters under the influence of specific personality traits.

## 6. Conclusion

The main objective of the current study was to demonstrate that personality traits are associated with investor ability to exhibit disposition effect, herding and overconfidence. The study also demonstrates how risk-attitude can modify (induce or prevent) investor behavior by moderating the association between personality traits, disposition effect, herding and overconfidence. This study supports Durand *et al.*, (2008) “auction” interpretation by suggesting that personality is associated with investment decision-making and personality traits determine investor trading behavior. It further supports the Durand *et al.*, (2008) assumption that “personality is the main driver of individual behavior.”

The finding shows that extraversion, conscientiousness and risk-attitude are associated with the disposition effect. This suggests that investors with extraversion and conscientiousness traits are more optimistic and rely on their own knowledge, skills and experience to make investment decisions. The overconfidence in their abilities and risk-attitude results in the early realization of profits (in early trade) (Durand *et al.*, 2013a) and retain the losing choices by increasing the riskiness of the portfolio. Furthermore, risk-attitude negatively moderates the association between extraversion, agreeableness and

disposition effect. This provides that investors with a high level of extraversion and agreeableness under risk-attitude have a lower tendency to exhibit disposition effect. Risk-attitude helps the individuals (extraversion and agreeableness) to carefully select, analyze and update portfolio and to make sound investment decisions without exhibiting disposition effect.

Neuroticism and extraversion are significantly associated with herding behavior, suggesting that negative emotions and extravert investors are more susceptible to exhibit herding behavior because of their less self-confidence and regret aversion. Moreover, risk-attitude provides a moderating effect on the association between neuroticism and herding behavior. Negative emotions and anxious investors under risk-aversion are more cautious and do not fully rely on their own judgments while investment decision-making. The study provides the significant positive impact of extraversion and conscientiousness on investor overconfidence. Extrovert and conscientiousness investors are more confident in their social skills, knowledge and decision-making abilities; therefore, they are more likely to exhibit overconfidence behavior. However, under a high level of risk-attitude conscientiousness trait investors use their knowledge and decision-making abilities in a more careful and cautious manner, which helps them to avoid overconfidence behavior and make more informed investment decisions.

The current study used insight from neuroscience and neurobiology to categorized human decision-making as “as if” or “dual process” paradigm. So, the future study can use dual process i.e. heuristics vs rational decision-making to check their influence on investors tend to exhibit disposition effect, herding and overconfidence. To measure the dual style of individual decision-making self-reported measures such as rational-experiential inventory (Pacini and Epstein, 1999) and cognitive style index (Allinson and Hayes, 1996; Hayes and Allinson, 1994) can be used. The current study used Mayfield *et al.*, (2008) revised 23-items NEO-FFI measurement for the big five personality model. Personality literature suggests that some of the big five items may result in the wrong classification, especially “neuroticism,” which measurement is replaced by the behavioral activation system and the behavioral inhibition system. Thus, future studies can follow the progress in personality literature and use the modified and revised behavioral measurements. Another drawback of this study is that it does not use real-time investment data to capture investor behavior. Future studies by following Durand *et al.*, (2008) can collect the data from real-time investors or can follow the experimental methodology of Durand *et al.*, (2013a) and Patterson and Diabler (2014) to capture a closer and relevant representation of real-time investors.

#### Note

1. Following induced value theory conditions of non-station and salience are fulfilled to ensure the motivation and engagement of respondents.

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