Learning Behaviour of Individual Investors and its Effect on their Behavioural Bias: The Mediating Role of Self-reflection

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Abstract

Adding a new perspective to the bias-learning behaviour of investors, this paper aims to explore how the trading experience produces learning effects to reduce their behavioural biases. A web-based self-administrated questionnaire survey was conducted to a random sample of 1000 individual investors of the Colombo Stock Exchange, of which 189 valid responses were received during the study period from March to August 2018. The data analysis was performed by applying the Structural Equation Modelling technique to test the hypotheses of the conceptual model. The findings reveal that the learning occurs when past trading experiences are self-reflected to assess the validity of the mental frames underlying those past decisions, which consequently minimizes herd bias. The results also show that this self-reflection process has a full mediating effect on the relationship between the experience and herd bias. Accordingly, contrary to the reinforcement learning assumption used in the previous studies, this paper concludes that the past experiences do not itself produce learning effects, rather, should be cognitively reflected upon to reduce behavioural biases in decision making. Nevertheless, it is also found that the self-reflection is not strengthened by the relationships with investment advisors and other investors, which could be attributed to the market uncertainties occurred during the period of the study and the dominance of unsophisticated investors in the market.

***Keywords**:* Adaptive market hypothesis, Colombo stock exchange, Herd bias; Structural Equation Modelling, Trading experience, Self-reflection, Individual learning

1. Introduction

In the behavioural finance literature, behavioural biases of investors have been documented as the most extensively used explanation for their poor investment performance and the inefficient functioning of financial markets (Barber & Odean, 2011; Filbeck et al., 2017). It reveals that investors tend to use simple heuristics in decision making due to factors such as market uncertainties, limited access to information, time pressure and their limited cognitive capabilities, which could result to decisions that are not adapted to market conditions. The literature further shows that such maladaptive decisions are caused by irrational information processing behaviours occurred with the heuristic decision-making, which are generally known as "behavioural biases" (Kumar & Goyal, 2015; Lo, 2004, 2005). Herding is one of the behavioural biases widely explored in the literature. It is one's tendency to ignore his/her own information and belief, and imitate what others do in making choices. Notwithstanding the evidence of herding during different market conditions and characteristics and its effects to the market functioning such as occurrence of speculative bubbles and crashes, it is noteworthy that certain previous studies find its decreasing trend over time (Shantha, 2018; Xiaofang & Shantha, 2018; Yao, Ma, & He, 2014). The study of Shantha (2019), conducted on the Colombo Stock Exchange (CSE) of Sri Lanka, reveals that this declining herd tendency is a result of the investors' learning attempts in response to the financial losses occurred from such irrational herd bias in the past. It implies that, as the Adaptive Market Hypothesis (AMH) of Lo (2004, 2005, 2012) predicts, the investors show a propensity to adapt to market environment by learning from the irrational behaviours occurred with their past decisions. In this manner, they would be able to select more appropriate investment strategies, and thereby increase their investment performance over time. Therefore, the investors' learning behaviour can be deemed as a key determinant of their investment performance. It would also enhance the efficient functioning of a financial market when their learning attempts would result to minimize behavioural biases at the aggregate market level.

The learning behaviour has extensively been studied in artificial market environments by forming agent-based financial models, which assume that investors learn on their own (known as "individual learning") as well as by imitating other investor behaviours (known as "social learning"). In case of the individual learning, the previous studies usually predict the reinforcement learning which means that investors' trial-and-error trading behaviours direct them to select better investment strategies for adapting to market environment. However, this reinforcement assumption as a component of the individual learning process has been debated in the literature, as discussed below. Pastore, Esposito, and Vasilaki (2015) show that the majority of agents in the study sample do not engage in reinforcement learning. The study of Hirshleifer (2015) shows evidence that reveals investors' tendency to merely extrapolate or over-extrapolate their own past experiences without appropriately reflecting on the

experiences. Hence, it argues that reinforcement learning can cause biases in the learning process. On the other hand, if the reinforcement learning holds true, a higher level of investment experience should lead to a lower level of behavioural biases and, thereby, to a greater investment performance. Conversely, the previous studies reveal mixed findings in respect of this prediction. In spite of the evidence supporting this reinforcement learning assumption (for example, Barber & Odean, 2011; Bradbury et al., 2014; List, 2011; Nicolosi et al., 2009), some contradictory findings appear in the literature as follows. Chevalier and Ellison (1999) show that investment experience is negatively related to investment performance. Agarwal, Driscoll, Gabaix, and Laibson (2007) find that the relationship between the experience and the performance takes an inverse U shape, which means that the performance is likely to decrease when the experience moves beyond a specific level. Further, Bhandari and Deaves (2006), Bodnaruk and Simonov (2015), Chang (2017), Wulfmeyer (2016) and Xiao (2015) reveal that the experience increases behavioural biases, which in turn decreases the performance.

Adding a new direction to this debate, the model of investor learning behaviour, proposed by Shantha, Xiaofang, and Gamini (2018) claim that past investment experience does not itself produce learning to reduce behavioural biases. Rather, it predicts that the learning occurs when the experiences are cognitively evaluated to justify the validity of the perspectives such as beliefs, thoughts and assumptions underlying those past decisions. Thus, this cognitive evaluation of the past experiences, also known as "self-reflection", is expected to play a mediating role on the relationship between the experience and behavioural biases. This study aims to explore whether herd bias is reduced through the mediating effect of this self-reflection in the individual learning behaviour of the retail investors of the CSE. The findings reveal that the self-reflection has a full mediating effect on the relationship between the experience and herd bias. Accordingly, while supporting the model's predictions, the results of the present study will contribute the literature a new perspective on the individual learning behaviour of investors. The investors can use it as a guide to improve their decision making so that their investment performance and market participation will be enhanced in the future.

The remainder of the paper is structured as follows. Section 2 elaborates the conceptual model and hypotheses of the study. The research methodology is discussed in Section 3. Section 4 presents the demography and the investment profile of the respondents, and discusses the results relating to the assessment of the reliability and validity of the model's constructs and the test of hypotheses to infer about the learning effect on herd bias. Section 5 concludes the paper.

2. Conceptual Model and Hypotheses

The model used in this work, as depicted in Figure 1, is based on the model of investor learning behaviour, proposed by Shantha et al. (2018). It provides a comprehensive view of the learning process by integrating cognitive, affective, behavioural and social aspects of learning. The model assumes that an investor learns individually through the self-reflection of his/her own past experiences. It is the cognitive evaluation of the validity of the perspectives such as beliefs, thoughts and assumptions underlying the investor's past trading decisions. In this manner, it facilitates to revise biased perspectives so that future trading decisions would be based on the revised perspectives. Accordingly, the self-reflection is the mechanism of the individual learning that reduces herd bias, as hypothesized below.

H1: An investor's trading experience (TE) is positively related to the extent of self-reflection (SR) he/she involves when learning.

H2: The level of SR is negatively related to the extent of herd bias (HERD) that occurred when trading stocks.

H3: SR mediates the relationship between TE and HERD.

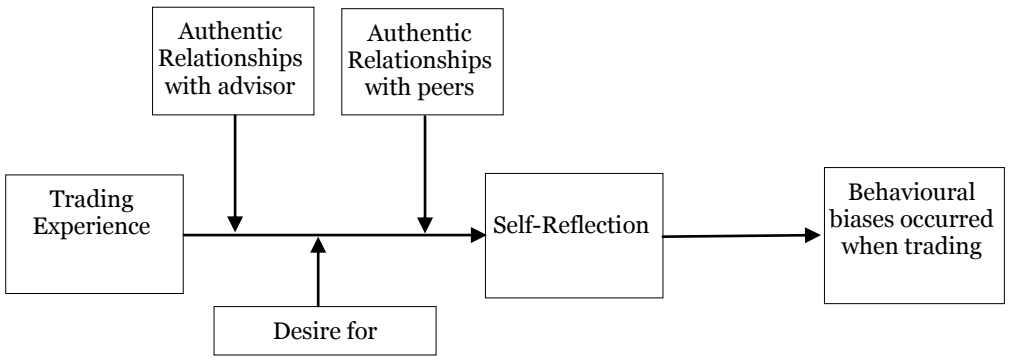

Figure 1: Conceptual Framework of Investor Learning Behaviour
(Adopted from Shantha et al. (2018))

In addition, the model assumes that the extent of the self-reflection is strengthened through the relationships with investment advisor and other investors, since such social interactions facilitate to receive appropriate guidance, information and practical knowledge to be aware of the biased perspectives occurred during previous trading decisions. As predicted by Shantha et al. (2018), when the relationships are authentic, investors feel a higher trustworthiness of

the knowledge and information received; hence, the extent of self-reflection is greater, as given by the hypotheses H4 and H5.

H4: Authentic relationship with the investment advisor (ARAD) positively moderates the positive relationship between TE and SR.

H5: Authentic relationships with other investors (AROT) positively moderate the positive relationship between TE and SR.

The model further predicts that an investor's affects such as interest, emotions and attention motivate towards learning since these affects are integrated with the cognitive functioning of the brain. Thus, they influence the efficiency and effectiveness of the self-reflection process. Accordingly, it is expected that an investor's desire for learning has a positive moderating effect in the self-reflection process, as shown by the hypothesis H6.

H6: Desire for learning (DL) positively moderates the positive relationship between TE and SR.

3. Methodology

Data was collected through a web-based questionnaire survey conducted from March to August 2018. The questionnaire consisted of the question items relating to the demography and investment profile of the respondents and the measurement of the extent to which they were characterised by each of the model's construct. A random sample of 1000 individual investors of the CSE whose security accounts had been active during previous six months, were invited to respond to the questionnaire. However, only 189 valid responses were received, which indicates a response rate of 19%. The investors were apparently panicked and frustrated due to the uncertain market environment that had prevailed during the study period, which could be regarded as the main cause of this low response rate. The non-response bias, tested in accordance with the procedure suggested by Dooley and Lindner (2003), was not apparent in the responses received.

Considering the exploratory nature of this study, the data analysis was performed using the Partial Least Squares Structural Equation Modelling technique, powered by Smart PLS 3 software (Becker, Rai, & Rigdon, 2013; Evermann & Tate, 2016; Sarstedt, Ringle, & Hair, 2017). In the analysis process, first, the measurement model was assessed to confirm the measurement quality of the model's constructs, and afterwards, the structural model was evaluated for hypothesis testing (Sarstedt et al., 2017). Since the model's constructs were reflectively defined, the indicator reliability, internal consistency reliability, convergent

validity and discriminant validity of the constructs were assessed to confirm their measurement quality. The evaluation of the structural model included the checking for collinearity issues by analyzing the variance inflation factor (VIF), the assessment of the predictive capability based on the coefficient of determination (R^2), cross-validated redundancy (Q^2) and effect-size (f^2), and the hypothesis testing by referring to the significance of path coefficients.

4. Results and Discussion

4.1. Respondents' demography and investment profile

The analysis of the respondents' demography reveals that male respondents are 71.4 percent of the responses received. In addition, about 40 percent of them are below the age level of 35 years, and 44 percent of them are in the age group of 35–54 years. Further, about half of the respondents have a bachelor's degree or a higher education qualification. In terms of the employment, the respondents are spread over private sector (78.3 percent), public sector (4.8 percent), retired (5.8 percent), self-employed (8.5 percent) and unemployed (2.6 percent) categories. Thus, the sample seems to fairly characterize the demographics of the individual investor population in the CSE. The average trading experience of the respondents is 11 years with the standard deviation of 6.18, as reflected by 4.8 percent having 2 years or less experience, and 11.1 percent possessing 18 or more years of experience. Concerning about the trading frequency, the majority (59.3 percent) trades occasionally, whereas only a small proportion of the respondents (9.5 percent) trades on a daily basis. The respondents who are characterized by low risk appetite (46.6 percent) are higher than those with a high risk appetite (30.6 percent). As a result, the majority of them exhibits a lower propensity for stock investments, as reflected by 20.1 percent holding less than 5 percent, and 48.1 percent holding 5–15 percent of wealth in stock. Accordingly, the risk appetite, trading frequency and proportion of stock investment are appearently at a low level for a majority of the respondents during the study period, which could be due to the uncertain trading environment that prevailed in the CSE during this period.

4.2. Reliability and Validity of Measurements

Tables 1 to 3 report the results in respect of the reliability and validity of the model's constructs. Table 1 shows that the indicator items exhibit an acceptable level of their reliability as their loading values are higher than 0.7 level on their respective constructs. The Cronbach's Alpha and the Composite Reliability values of all the constructs are also greater than 0.7, which indicate a high level of the internal consistency reliability. In addition, all the constructs demonstrate the average variance extracted values in excess of the cut-off level of

0.5, confirming their convergent validity. The Fornell and Larcker criterion (as shown in Table 2) and the Heterotrait-monotrait criterion (as shown in Table 3) analyses reveal strong evidence of the constructs' discriminant validity. Further, the Variance Inflation Factor values, as given in Table 4, confirm the absence of multi-collinearity issues in the model as these values are below five.

Table 1: Evaluation of the Measurement Quality of the Model's Constructs

Construct	Indicator Item	Indicator Loading	Cronbach's Alpha	Composite Reliability	Average Variance Extracted
ARAD	Arad_1	0.866	0.876	0.891	0.671
	Arad_2	0.777			
	Arad_3	0.810			
	Arad_5	0.821			
AROT	Arot_1	0.681	0.848	0.888	0.614
	Arot_2	0.797			
	Arot_3	0.822			
	Arot_4	0.790			
	Arot_5	0.820			
DL	Dl_1	0.799	0.911	0.928	0.618
	Dl_2	0.819			
	Dl_3	0.806			
	Dl_4	0.827			
	Dl_6	0.748			
	Dl_7	0.733			
	Dl_8	0.763			
	Dl_9	0.788			
HERD	Herd_1	0.889	0.824	0.892	0.734
	Herd_2	0.815			
	Herd_3	0.865			
SR	Sr_1	0.565	0.880	0.883	0.527
	Sr_2	0.533			
	Sr_3	0.819			
	Sr_4	0.838			
	Sr_5	0.650			
	Sr_6	0.815			
	Sr_7	0.790			
TE	TradeYrs	1.000	1.000	1.000	1.000

Note: This table shows the indicator items' loading, the Cronbach's Alpha, the Composite Reliability and the Average Variance Extracted values for evaluating the measurement quality of the model's constructs. An indicator loading value greater than 0.5 shows the indicator reliability (Hulland, 1999). A set of indicators to measure each construct was arrived from the loading relevant test (Wong, 2016). The Cronbach's Alpha and the Composite Reliability values greater than 0.7 indicate the internal consistency reliability of the respective constructs (Gefen, Straub, & Boudreau, 2000; Nunnally & Bernstein, 1994). The Average Variance Extracted value greater than 0.5 represents the convergent validity (Bagozzi & Yi, 1988; Fornell & Larcker, 1981).

Table 2: The Fornell-Larcker Criterion Analysis for Evaluating Discriminant Validity

	ARAD	AROT	DL	HERD	SR	TE	Discriminant Validity met?
ARAD	0.819						Yes
AROT	0.428	0.784					Yes
DL	0.421	0.530	0.786				Yes
HERD	-0.116	0.101	-0.190	0.857			Yes
SR	0.336	0.311	0.542	-0.313	0.726		Yes
TE	0.101	0.166	0.185	-0.012	0.205	Single item	Yes

Note: This table shows the square root of the average variance extracted value of each construct (as given on the diagonal and printed in bold) and its correlations with other constructs (as shown by non-diagonal elements). The discriminant validity is met when square root of the average variance extracted value of a construct is greater than its correlation coefficients with other constructs (Fornell & Larcker, 1981).

Table 3: The Heterotrait-monotrait Criterion Analysis for Evaluating Discriminant Validity

	ARAD	AROT	DL	HERD	SR	TE
ARAD						
AROT	0.463					
DL	0.456	0.589				
HERD	0.165	0.186	0.212			
SR	0.353	0.324	0.597	0.353		
TE	0.117	0.172	0.193	0.014	0.226	

Note: This table reports the Heterotrait-monotrait ratio of correlations between the model's constructs. The discriminant validity is confirmed if these values are less than 0.85 (Henseler, Ringle, & Sarstedt, 2015).

Table 4: The Variance Inflation Factor Values for Testing the Multicollinearity

	ARAD	AROT	DL	SR	TE
SR	1.385	1.530	1.696		1.123
HERD				1.000	

Note: This table shows the Variance Inflation Factor values of exogenous constructs (given in column wise) with respect to their endogenous constructs (given in raw wise) for the examination of the multicollinearity. The multicollinearity is absent if this value is less than 5 (Cassel, Hackl, & Westlund, 1999; Hair, Ringle, & Sarstedt, 2011).

4.3. Learning Behavior of Investors

Figure 2 depicts the main results relating to the investors' learning behavior. R^2 values of SR and HERD constructs are 37.8 percent and 9.3 percent respectively. Q^2 values of SR and HERD constructs are 0.177 and 0.062 respectively, which indicate an acceptable level of the path model's predictive accuracy and relevance (Sarstedt et al., 2017). Table 5 presents the hypotheses testing results relating to the learning behavior of the investors. As shown in Part A of the table, consistent with H1, the trading experience positively impacts on the extent of self-reflection that occurs when learning. An increase in one standard deviation of TE construct increases SR construct by 19.3 percent standard deviation ($f^2 = 0.049$, $p < 0.01$).

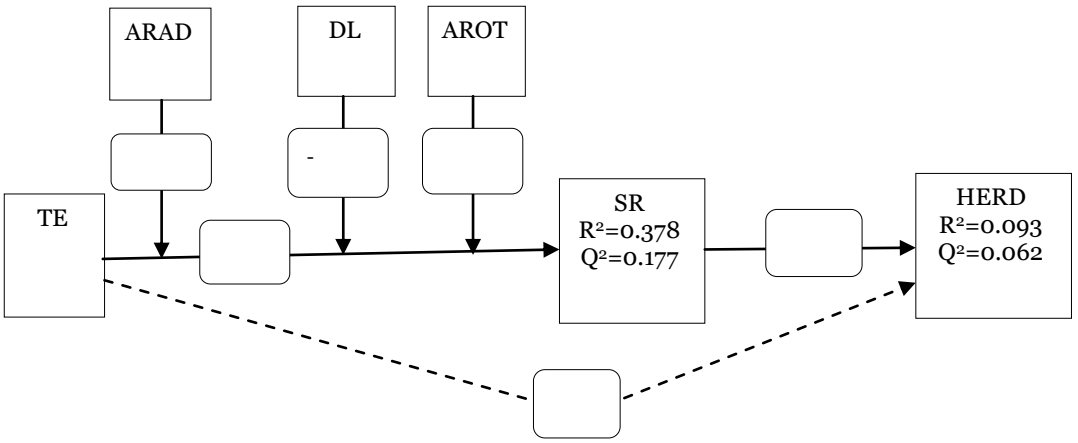

Figure 2: Main Results of the Investors' Learning Behavior

Note: The significance at 1 percent and 5 percent levels are denoted by ** and *respectively.

Table 5: Estimates of Model's Path Coefficients, Significance and Effect Sizes

Hypothesis	Path	Path coefficient	Standard error	t-value	p-value	Decision	f^2
Part A: Effect of trading experience on self-reflection and herd bias							
H1	TE→SR	0.193	0.068	2.687	0.004**	Accept	0.049
H2	SR→HERD	-0.315	0.081	3.860	0.000**	Accept	0.108
H3	TE→SR→HERD	-0.061	0.028	2.056	0.020*	Accept	
	TE→HERD	-0.017	0.117	0.153	0.439		
Part B: Moderating effect of authentic relationship with investment advisor on self-reflection							
H4	ARAD*TE→SR	-0.066	0.088	0.820	0.206	Reject	0.005
	ARAD*TE→SR→HERD	0.021	0.029	0.775	0.219		
Part C: Moderating effect of authentic relationship with other investors on self-reflection							
H5	AROT*TE→SR	-0.201	0.092	2.158	0.015*	Reject	0.031
	AROT*TE→SR→HERD	0.063	0.033	1.875	0.030*		
Part D: Moderating effect of desire for learning on self-reflection							
H6	DL*TE→SR	-0.085	0.103	0.841	0.200	Reject	0.006
	DL*TE→SR→HERD	0.028	0.035	0.779	0.218		

Note: This table shows the results relating to the test of the model's hypotheses. The significance at 1 percent and 5 percent levels are indicated by ** and * respectively. f^2 denotes effect-size of path's exogenous variable on its endogenous variable. As a rule of thumb, f^2 values of 0.02, 0.15 and 0.35 represent the cut-off values for small, medium and large effects (Cohen, 1988).

In addition, the findings confirm H2, indicating that an increase in one standard deviation of SR construct reduces HERD construct by 31.5 percent standard deviation ($f^2 = 0.108$, $p < 0.01$). These findings are consistent with those of Shantha (2019) which reveal the investors' learning tendency to shift away from herd behaviour when trading stocks. Further, supporting H3, SR construct mediates the association between TE and HERD constructs at 5 percent level of significance. Nevertheless, the results do not confirm for the direct negative effect of trading experience on herd bias (TE→HERD). Thus, consistant with the previous studies discussed in section 1, it appears that the reinforcement learning assumption does not adequately represent the learning beaviour of investors. Accordingly, SR has a full mediating effect on the association between TE and HERD (Zhao, Lynch, & Chen, 2010).

When concerning the moderating effects, as assumed by H4, H5 and H6, the findings indicate their absence in the learning process during the study period, which could be ascribed to the market uncertainties prevailed during this period and the dominance of unsophisticated investors in frontier markets like the CSE. The uncertain market conditions might have triggered the investors to be more risk averse, thereby, reduced their stock holding and trading frequency. Consequently, investors might be less motivated for stock trading, resulting to a low level of interaction with their investment advisors. Hence, the moderating

effect of ARAD in the self-reflection process is not evident. Further, as a frontier market, unsophisticated investors dominate the CSE. As a result, investors' peer-relationships (AROT) may not facilitate for obtaining quality information to strengthen their learning process, which can be considered as the most likely reason for the absence of the moderating effect of AROT in the self-reflection process.

5. Conclusion

To the best of my knowledge, this study is the first to address the debate on the relationship between the investment experience and behavioural biases. The key conclusions are as follows.

- Contrary to the reinforcement learning assumption used in the previous agent-based studies, the findings of this study confirm that the self-reflection of the past experiences has a full mediating effect on the relationship between the experience and behavioural biases occurred in stock trading. Accordingly, the past trading experiences do not itself produce learning effects, rather, should be cognitively reflected upon to minimize behavioural biases.
- This study attributes the absence of moderating effects from the relationships with investment advisors and other investors, and desire for learning the uncertain market conditions occurred during the study period and dominance of unsophisticated investors in the CSE. Accordingly, it is evident that market conditions have an influence on the extent of learning that takes place within an individual investor.

Future work can focus on extending the studies of this kind to other forms of behavioural biases; for example, heuristic and prospect biases. In addition, similar studies can be conducted in respect of other investor types such as institutional investors and financial analysts, and other market categories such as developed and emerging markets for enhancing the knowledge about the learning behaviour of investors.

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