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Investors' Expertise, Personality Traits and Susceptibility to Behavioral Biases in the Decision Making Process

Marcin Rzeszutek¹, Adam Szyszka², Monika Czerwonka³

ABSTRACT

The aim of this paper is to investigate the degree of susceptibility to behavioral biases (the certainty effect, the sunk cost fallacy, and mental accounting) among people of various levels of expertise in market investments and to determine whether this susceptibility is correlated with certain personality traits (impulsivity, venturesomeness, and empathy). The study included 200 participants: 100 retail investors who regularly invest in the Warsaw Stock Exchange and 100 students of the Warsaw School of Economics who are casually involved in investing. In this study, employing a survey methodology, we conducted a laboratory experiment that allowed us to isolate behavioral biases and personality traits and measure their influence on investors' decision-making processes. The participants filled out questionnaires containing two parts: 1) three situational exercises, which assessed susceptibility to behavioral biases, and 2) the Impulsivity, Venturesomeness, Empathy Questionnaire (IVE) Questionnaire which measures three personality traits (impulsivity, venturesomeness, and empathy). Statistical analyses demonstrated that susceptibility to behavioral biases depends on the level of expertise in market investing such that expertise increases susceptibility to behavioral biases. Some personality traits influenced the participants' likelihood of displaying these biases.

KEY WORDS: investors' expertise; personality traits; behavioral biases; rationality; behavioral finance

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¹ University of Finance and Management - Faculty of Management and Finance, Warsaw, Poland; ² Warsaw School of Economics - Department of Capital Markets, Poland; ³ Warsaw School of Economics - Department of Finance, Poland

1 Introduction

There is a vast literature dedicated to showing that neo-classical finance theory does not properly depict the real behavior of an investor in a stock market and that the investment decision-making process is greatly shaped by psychological factors, such as moods, emotions and

personality traits (Akerlof & Schiller, 2009; De Bondt & Thaler, 1987; Kahneman 2012; Szyszka & Zielonka, 2007; Todd & Gigerenzer, 2003). Abundant evidence from psychological research that suggests that humans have restrained cognitive possibilities, are controlled by emotions, and succumb to mob mentality while making choices in risky and uncertain situations, drew financial behaviorists' attention to the drawbacks of the *homo economicus* assumption and the hypothesis about the market's efficiency (Fama, 1970; 1991; Markowitz, 1952; Von Neumann & Morgenstern, 1944) and the suscepti-

Correspondence concerning this article should be addressed to: **Marcin Rzeszutek**, University of Finance and Management - Faculty of Management and Finance, Pawia 55, 01-030 Warsaw, Poland. T: +48 22 536 54 11. E-mail: rzeszutek@vizja.pl

bility of investors to so-called behavioral biases resulting from cognitive biases and heuristics as well as emotions (Agnew, 2006). These biases disrupt the rationality of the process of making investment decisions and contribute to inefficient market reactions to information and, as a result, to asset mispricing (Coval & Shumway, 2005; Rzeszutek & Czerwonka, 2011). Szyszka (2010) proposed the Generalized Behavioral Asset Pricing Model, which shows how asset prices can be influenced by various behavioral biases and how prices may deviate from fundamental values due to investors' irrational behavior. The model distinguishes three behavioral variables that are linked to errors in understanding and transforming information signals, problems with representativeness and probability judgment, and unstable preferences. In this paper, we investigate three examples of behavioral phenomena that are captured by this model: the certainty effect, the sunk-cost fallacy, and mental accounting. In particular, we look at how these three important behavioral phenomena manifest among investors depending on their level of expertise and personality traits, such as impulsivity, venturesomeness, and empathy.

1.1 Certainty Effect

Daniel Kahneman and Amos Tversky noted many anomalies in how individual preferences are shaped in situations of uncertainty and risk (1973; 1979; 1984). One such anomaly is the certainty effect: the tendency to overweight outcomes that are certain compared with outcomes that are highly probable. For example, Kahneman (2012) observed that a substantial majority of participants prefer a certainty of winning \$850 to a 90% probability of winning \$1,000, although the expected value of the latter option is actually higher. Overweighting a certain win over a highly probable option, as in the example above, prompts people to choose an option with a lower expected value. Therefore, the certainty effect was shown to lead to potentially less profitable investment decisions in the capital market (Agnew, 2006).

1.2 Sunk-Cost Fallacy

Making decisions in conditions of risk and uncertainty is also dependent on the sunk cost fallacy, which describes the influence of costs incurred in the past on future investment decisions (Arkes & Blumer,

1985). According to neoclassical finance theory, only an analysis of current and future losses and profits should influence these decisions (Bernstein, 2007). However, investors all too often attach importance to outlays made in the past toward a given investment, and these past costs significantly influence both present and future decisions (De Bondt & Makhija, 1988). On the stock market, this overweighting of past costs often leads to retaining positions that generate costs for too long and sometimes even to purchasing more shares after declines (Friedman et al., 2007). In doing so, investors seek to reduce the average price of purchasing a share in the hopes that they will be able to record profits more quickly after a small economic upturn (Connolly & Zeelenberg, 2002; McAfee, Mialon, & Mialon, 2010).

1.3 Mental Accounting

Mental accounting is a process of mentally coding, categorizing, and evaluating cash flow, i.e., recording particular expenditures and revenues in various mental accounts (Thaler, 1999). The mental accounting effect undermines the principle of substitutability, which claims that money has no label, i.e., that the source of funds is irrelevant in the spending of them (Haigh & List, 2005). Stock market investors do not follow this principle but rather display mental accounting and treat profits attained as dividends (cash) differently from identical "paper" profits—those resulting from an increased exchange rate (Winnett & Lewis, 1994). It has also been observed that investors are incapable of closing losing positions and investing funds from those losing shares in new endeavors because these shares are treated as a separate mental account (Odean, 1998). Instead, many hope for changing trends to make up for those losses in the future, which leads to a progressive reduction in the worth of their investment portfolio.

1.4 Expertise and Rationality in Decision Making

Expertise or professional experience sometimes helps in making good decisions; however, equally often experts, aware of their knowledge within a given domain, can fall prey to various behavioral biases, sometimes even more so than naïve individuals (Braun & Yaniv, 1992; Krems & Zierer, 1994). Researchers have ana-

lyzed susceptibility to cognitive and emotional biases among professional investors compared with individuals who engage in the capital market on a more casual basis or even compared with complete novices (e.g., Camerer & Johnson, 1997; Tyszka & Zielonka, 2002). The results of these studies show that extensive experience in stock market investing does not protect people from behavioral biases. Professional investors are particularly vulnerable to divergence from rational action if a task is not transparent and there are no univocal indicators suggesting an appropriate solution (Garvey & Murphy, 2008). In these cases, professionals often fall back onto schemas and/or heuristics. What is surprising is that, after making the wrong decision, even as new information arises that clarifies the problem, professional investors can become more convinced of having a good understanding of the issue and do not change their initial stance (Verma, Baklaci & Soydemir, 2008). This conviction that they are right grows, despite an influx of information indicating their error in judgment.

1.5 Personality Traits and Susceptibility to Behavioral Biases among Stock Market Investors

Recent studies in behavioral finance incorporate personality into the analysis of investors' behavior to seek a deeper understanding of investors' decision-making processes and their performances in the stock market (Borghans et al., 2008; Jadow & Mowen, 2010). In particular, it has been observed that certain personality traits can influence investors' preferences (Chira, Adams & Thornton, 2008), risk attitudes (Mishra, Lalumiere & Williams, 2010) and investment choices and outcomes (Belcher, 2010; Pompian & Longo, 2004). Therefore, some authors state that individual differences in personality traits among investors can explain their susceptibility to various behavioral biases in the stock market investment process (Mayfield, Perdue & Wooten, 2008). For example, Durand, Newby & Sanghani, (2008) showed the positive relationship between extraversion and agreeableness from the Big Five personality traits (openness, conscientiousness, extraversion, agreeableness and neuroticism; Costa & McCrae, 1985) and the susceptibility to disposition effect and overconfidence among Australian investors. Additionally,

it has been observed that neuroticism from the Big Five is positively correlated with a propensity toward the sunk cost fallacy among Tehran investors (Sadi et al., 2011). Baddeley et al. (2010) also found an association between particular Eysenck's (1978) personality traits (impulsivity, venturesomeness and empathy) and susceptibility to social influence in financial decision making (herding) among British investors. From the abovementioned personality traits, impulsivity was negatively linked to the degree of hyperbolic discounting and the level of risk aversion in another study conducted on British investors (Borghans et al., 2008). Finally, impulsivity was also found to be a significant predictor of pathological gambling behavior (Alessi & Petry, 2003). Although exploring investors' personality traits seems to be a new and inspiring way to understand how investment decisions are made, there has not yet been a sufficient number of studies on this topic.

1.6 Purpose and Hypotheses

The first aim of this research is to investigate the degree of susceptibility to behavioral biases (the certainty effect, the sunk cost fallacy, and mental accounting) among people with various levels of expertise in investing, i.e., frequent retail investors at the Warsaw Stock Exchange (see further: investors) and casual investors (students of the Warsaw School of Economics; see further: students). A second goal of this research is to determine whether this susceptibility is correlated with certain personality traits (impulsivity, venturesomeness, and empathy). Because there is still a lack of data studies in behavioral finance literature investigating the issues noted in this article (or the existing results in behavioral finance literature are ambiguous), we treated our study as exploratory. Therefore, the following hypotheses were tested:

1. The degree of susceptibility to behavioral biases (see: certainty effect, sunk-cost fallacy and mental accounting) in decision making varies depending on an individual's amount of expertise in stock market investing.
2. Susceptibility to behavioral biases (see: certainty effect, sunk-cost fallacy and mental accounting) in decision making will be correlated with certain personality traits (impulsivity, venturesomeness, and empathy) in all participants.

2 Method

2.1 Participants and Procedure

This study was conducted on a convenience sample, with the subjects selected because they were available, and the researchers did not consider selecting subjects as representative of the entire population of investors in Poland (Freedman, 2009). Two hundred participants represented two 100-person groups, which differed in their level of expertise in stock market investing. The first group was made up of 100 retail investors frequently investing at the Warsaw Stock Exchange. These participants were recruited from among attendees of a conference organized by the Association of Individual Investors and from among trainees of advanced workshops organized by PERK, an organization that provides education about capital markets in Warsaw. The second group was made up of 100 students of the Warsaw School of Economics. These students had casual experience investing in the stock market and planned to pursue careers connected to the stock exchange. Basic demographic information and information about the level of stock market expertise is presented in Table 1.

As seen in Table 1, the study sample had similar gender distribution across the two subgroups of participants. The average age of the stock market investors was 33.19 years ($SD = 10.09$) and among the WSE students, the average age was 21.62 years ($SD = 1.89$). Among the stock market investors, 96 had completed tertiary education and 4 had obtained PhDs. Among the WSE students, 78 had completed secondary education and 22 had obtained MAs or BAs in economics. The average number of years of investing on the Warsaw Stock Exchange was 6.56 ($SD=1.95$) among investors and 1.76 ($SD = 1.64$) among students. Finally, the average value of the stock portfolio (PLN) among investors was 1,49300 PLN ($SD = 2,27796.89$), and it was 1,0450 PLN ($SD = 1,5326.33$) among students.

In this study, in which a survey methodology was employed, we conducted a laboratory experiment that allowed us to isolate behavioral biases and personality traits and measure their influence on investors' decision-making processes. The questionnaires were in hard copy form and were delivered to the participants in person so that they could also be informed about the anonymity of individual results and all other necessary

details. The participants filled out the surveys in Polish, and the total distribution study response rate was approximately 65%.

2.2 Materials

The study questionnaire contained two parts. First, the participants completed a form featuring three situational scenarios (see, Appendix), in which they had to choose how they would behave in a hypothetical situation when faced with a number of options. In each scenario, susceptibility to the behavioral biases noted in the hypotheses was assessed. These scenarios have been used in classical studies on decision making. In the first scenario, adapted from Kahneman & Tversky (1979), propensity toward the certainty effect was measured. The second scenario, adapted from Thaler (1999), checked susceptibility to mental accounting. The last scenario, adapted from Arkes and Blumer (1985), measured propensity toward the sunk cost fallacy. The questionnaire also asked about the above-mentioned demographics, including age, gender, education and investing expertise.

In the second part of the questionnaire, the participants completed the IVE Questionnaire (Impulsivity, Venturesomeness, Empathy Questionnaire; Eysenck & Eysenck, 2006). This tool is used to measure three personality traits: impulsivity, venturesomeness, and empathy. Impulsivity is defined as the pathological aspect of risk-taking behavior and indicates a very strong tendency to undertake risky, unplanned activities, to make quick decision and to have rash reactions. It is primarily manifested in problems with self-control and the inability to delay gratification. Venturesomeness measures not only readiness to undertake risky behaviors but also self-confidence, self-efficacy, persistence in goal pursuit, and novelty seeking. Although this trait is similar to impulsivity, the two traits differ in that impulsive people take risks without considering the consequences of their actions, whereas venturesome people seek out challenges and take risks, all the while taking into account the possible consequences of their actions. Finally, empathy is the ability to perceive, understand and react to others' emotions and take on others' emotional perspectives (Eysenck & Eysenck, 1978). The IVE comprises 54 items in the form of questions with yes/no answers. Final scores are calculated by totaling the "yes" answers to the items

Table 1. Participants' basic demographic information and stock market investment expertise

Group	Gender	Age	Education	Years investing in the stock market	Value of stock portfolio (PLN)
1. Stock market investors (n = 100)	Men	<i>M</i> = 33.19 <i>SD</i> = 10.09	Primary = 0 Secondary = 0	<i>M</i> = 6.56 <i>SD</i> = 1.95	<i>M</i> = 1,49300.00 <i>SD</i> = 2,27796.89
	Women	Range 28-62	Tertiary (MA or BA) = 96 PhD = 4	Minimum = 2 Maximum = 27	
2. Students (n = 100)	Men	<i>M</i> = 21.62 <i>SD</i> = 1.89	Primary = 0 Secondary = 78	<i>M</i> = 1.76 <i>SD</i> = 1.64	<i>M</i> = 1,0450.00 <i>SD</i> = 1,5326.33
	Women	Range 18-30	Tertiary (MA or BA) = 22 PhD = 0	Minimum = 0 Maximum = 4	

(some are reverse-scored) on three subscales: impulsivity, venturesomeness, and empathy. The reliability coefficients for the three IVE subscales range from $\alpha = .76$ to $\alpha = .81$ (Eysenck & Eysenck, 2006). The reliability coefficients for the subscales in this study were $\alpha = .79$ for impulsivity, $\alpha = .78$ for venturesomeness, and $\alpha = .72$ for empathy.

3 Results

Statistical analyses were conducted using PASW Statistics 18. To test the first hypothesis concerning the link between investing expertise and the degree or rationality of decision making as measured through the three behavioral biases contained in the exercises, a series of χ^2 tests of the independence of two variables were conducted. Three comparisons were made. In each, one variable was the group of participants (investors or students); the other variable was making a rational or irrational decision in each of the three exercises (see: Appendix). For a rational answer (one that showed no behavioral bias), a participant received 1 point. For an irrational answer (one that showed the bias), the participant received no points. For example, the first exercise in the questionnaire measured susceptibility to the certainty effect. Option A was considered the rational answer in the first part of the exercise; option C was considered rational in the second part (see: Appendix). These options had the greatest expected value. Therefore, a subject received 1 point for this exercise if he/she circled both A and C and 0 points otherwise. The other choices had lower expected values; as a re-

sult, they were coded as irrational in accordance with Kahneman and Tversky's study (1979).

To assess whether the investors differed from the students with regard to susceptibility to the certainty effect, a χ^2 test of the independence of the two variables was performed. The results are shown in Table 2. The frequencies of rational answers by investors versus students were compared, showing relative susceptibility to the certainty effect.

A significant χ^2 result allows us to reject the null hypothesis about the independence of the two variables and accept the alternative hypothesis, that the two variables are somehow related. In the case of the certainty effect, the group of students behaved significantly more rationally (39 rational answers) than the group of investors (26 rational answers), $\chi^2(1, N = 200) = 3.85; p < .05$. The investors, thus, were shown to be more susceptible to the certainty effect than the students.

The same analysis was performed to investigate whether the investors differed from the students with regard to susceptibility to the sunk cost fallacy. The results are shown in Table 3.

In the case of the sunk cost fallacy, the difference in answers measuring susceptibility to the sunk cost fallacy between the investors and students was not significant, $\chi^2(1, N = 200) = .10; ns$.

An identical analysis was performed to determine whether the investors differed from the students with regard to susceptibility to mental accounting. The results are shown in Table 4.

Table 2. Outcome of χ^2 test for frequency of rational answers of stock market investors and WSE students in the exercise measuring susceptibility to the certainty effect

The certainty effect	Stock market investors	WSE students	Chi ²	df	p
	26	39			

Table 3. Outcome of χ^2 test for frequency of rational answers of stock market investors and WSE students in the exercise measuring susceptibility to the sunk cost fallacy

The sunk cost fallacy	Stock market investors	WSE students	Chi ²	df	p
	31	29			

Table 4. Outcome of χ^2 test for frequency of rational answers of stock market investors and WSE students in the exercise measuring susceptibility to mental accounting

Mental accounting	Stock market investors	WSE students	Chi ²	df	p
	40	53			

Table 5. Means and standard deviations for personality traits among stock market investors and students (N = 200)

	Stock market investors (n = 100)		WSE students (n = 100)		t-test comparing investors to students
	M	SD	M	SD	
Impulsivity	7,55	3,60	8,45	3,41	-1,82#
Venturesomeness	9,15	3,24	10,06	3,14	-2,01*
Empathy	11,06	3,77	11,59	3,55	-1,02

Note: # $p < .10$; * $p < .05$.

In the case of mental accounting, we observed a trend towards statistical significance, $\chi^2(1, N = 200) = .061$. The students' group (53 rational answers) behaved in a more rational way than the investors (40 rational answers).

In the next stage of statistical analyses, we sought to check whether the two groups of participants differed

from each other within the level of personality traits. A t-test for independent groups was conducted. The results are presented in Table 5, which shows means and standard deviations for personality traits among the stock market investors and students. We performed a suitable analysis in regard to gender; however, no statistically significant differences were found.

As shown in Table 5, the students were significantly more venturesome and marginally more impulsive than the investors. The two groups did not differ in their levels of empathy.

To test the second hypothesis, logistic regression analyses were conducted. Susceptibility to behavioral biases was the outcome variable. Personality traits (impulsivity, venturesomeness, and empathy) were the predictor variables. We note that logistic regression is the method of choice for analyzing results of studies in which the dependent variable is dichotomous while the independent variables are interval or categorical (Freedman, 2009). This was the case in our study. It is possible to make use of discriminant analysis in these cases; however, it was found that logistic regression outperforms discriminant analysis for non-normal classification problems, which was also the case in our study. Additionally, while ordinary regression uses ordinary least squares to search for a best fitting line and addresses coefficients that predict the change in the outcome variable for one unit change in the predictor variable, logistic regression estimates the probability of an event occurring (Freedman, 2009). Furthermore, while in linear regression, the relationship between the outcome and the predictor variables is linear; this assumption is not made in logistic regression. Taking the abovementioned factors into account, in our study, we used this statistical method because the outcome variable was categorical (see: making a rational or irrational decision in each of the three exercises) and the predictor variables were continuous (see: personality traits). Finally, we emphasize that the participants' age and other demographics (gender, education) were not statistically significant variables in our model; consequently, we did not control for them in our analyses. Three analyses were performed, one for each of the exercises in the questionnaire. The results are shown in Tables 6, 7, and 8.

The results shown in Table 6 indicate that there was no significant relationship between impulsivity or empathy and susceptibility to the certainty effect in our sample as a whole (respectively, $p = .967$ and $p = .14$). There was, however, a significant relationship between venturesomeness and susceptibility to the certainty effect ($p < .05$). Specifically, the more venturesome a participant was, the more likely he was to give a rational answer ($\text{Exp}(B) > 1$) and thus, the lower his suscepti-

bility to the certainty effect. We can accurately predict rational answers to the certainty effect exercise based on level of venturesomeness in 72% of our cases.

The results shown in Table 7 indicate that there is no relationship between impulsivity or empathy and susceptibility to the sunk cost fallacy in our sample (respectively, $p = .434$ and $p = .480$). There was a significant relationship between venturesomeness ($p < .05$) and susceptibility to the sunk cost fallacy. Specifically, the more venturesome one was, the more likely he was to give a rational answer in the sunk cost exercise ($\text{Exp}(B) > 1$). We can accurately predict rational answers in the sunk cost exercise based on venturesomeness in 74% of our cases.

The results in Table 8 show that there was no relationship between impulsivity or empathy and tendency to mental accounting in our sample ($p = .620$ and $p = .668$, respectively). There was, however, a relationship between venturesomeness ($p < .001$) and susceptibility to mental accounting. Specifically, greater venturesomeness was linked to a lower susceptibility to mental accounting when making decisions ($\text{Exp}(B) > 1$). On the basis of venturesomeness levels, we can predict rational answers in the mental accounting exercise in 62% of our cases.

To verify whether the relationship between venturesomeness and susceptibility to the studied behavioral biases was identical or different in the two groups of participants, we conducted a logistic regression in which the predictors were the particular group of participants, venturesomeness, and the interaction between these two variables. In other words, membership in one of the two participant groups was treated as a moderator of the relationship between venturesomeness and the probability of making rational decisions in the three exercises.

The results shown in Table 9 indicate that the interaction between group and venturesomeness was not significant; thus, group belonging did not moderate the relationship between venturesomeness and making rational decisions.

To verify whether the relationship between impulsivity and susceptibility with the studied behavioral biases was identical or different in the two groups of participants, we conducted a logistic regression in which the predictors were the particular group of participants, impulsivity, and the interaction between these two vari-

Table 6. Logistic regression analysis with personality traits as predictors of susceptibility to the certainty effect in the sample as a whole (N = 200)

Personality traits	B	Exp (B)	Wald	df	p
Impulsivity	-.03	.97	.56	1	.967
Venturesomeness	.11	1.11	4.01	1	.041
Empathy	-.07	.94	2.21	1	.14

Table 7. Logistic regression analysis with personality traits as predictors of susceptibility to the sunk cost fallacy in the sample as a whole (N = 200)

Personality traits	B	Exp (B)	Wald	df	p
Impulsivity	-.04	.96	.61	1	.434
Venturesomeness	.12	1.12	4.56	1	.032
Empathy	-.03	.97	.48	1	.480

Table 8. Logistic regression analysis with personality traits as predictors of susceptibility to mental accounting in the sample as a whole (N = 200)

Personality traits	B	Exp (B)	Wald	df	p
Impulsivity	-.02	.98	.25	1	.620
Venturesomeness	.20	1.22	14.28	1	.001
Empathy	-.01	1.02	.18	1	.668

ables. In other words, membership in one of the two participant groups was treated as a moderator of the relationship between impulsivity and the probability of making rational decisions in the three exercises.

The results shown in Table 10 indicate that the interaction between group and impulsivity was not significant; thus, group belonging did not moderate the relationship between impulsivity and making rational decisions.

To verify whether the relationship of empathy and susceptibility to the studied behavioral biases was identical or different in the two groups of participants,

we conducted a logistic regression in which the predictors were the particular group of participants, empathy, and the interaction between these two variables. In other words, membership in one of the two participant groups was treated as a moderator of the relationship between empathy and the probability of making rational decisions in the three exercises.

The results shown in Table 11 indicate that the interaction between group and empathy was not significant; thus, group belonging did not moderate the relationship between empathy and making rational decisions.

Table 9. Analysis of interaction in logistic regression, where group (stock market investors vs. WSE students) is a moderator of the relationship between venturesomeness and likelihood of making a rational decision in each of the three exercises

	B	Exp(B)	Wald	df	p
The certainty effect Group x V	-.01	.99	.01	1	.940
The sunk cost fallacy Group x V	.13	1.14	1.44	1	.230
Mental accounting Group x V	-.06	.94	.40	1	.528

Note: V – venturesomeness; B – unstandardized regression coefficient; Exp(B) – standardized regression coefficient; Wald – Wald test result; df – degrees of freedom; p – statistical significance.

Table 10. Analysis of interaction in logistic regression, where group (stock market investors vs. WSE students) is a moderator of the relationship between impulsivity and likelihood of making a rational decision in each of the three exercises

	B	Exp(B)	Wald	df	p
The certainty effect Group x I	-.17	.84	3.60	1	.068
The sunk cost fallacy Group x I	.01	1.01	.02	1	.875
Mental accounting Group x I	.03	1.03	.13	1	.723

Note: I – impulsivity; B – unstandardized regression coefficient; Exp(B) – standardized regression coefficient; Wald – Wald test result; df – degrees of freedom; p – statistical significance.

Table 11. Analysis of interaction in logistic regression, where group (stock market investors vs. WSE students) is a moderator of the relationship between empathy and likelihood of making a rational decision in each of the three exercises

	B	Exp(B)	Wald	df	p
The certainty effect Group x E	-.05	.95	.40	1	.529
The sunk cost fallacy Group x E	-.06	.94	.46	1	.497
Mental accounting Group x E	.03	.13	.13	1	.722

Note: E – empathy; B – unstandardized regression coefficient; Exp(B) – standardized regression coefficient; Wald – Wald test result; df – degrees of freedom; p – statistical significance.

4 Discussion

First, statistical analyses demonstrated that susceptibility to behavioral biases depends on the level of expertise in stock market investing. Second, in our sample, we observed an influence of certain personality traits on susceptibility to behavioral biases.

We found not only that frequent retail investors are susceptible to various behavioral biases when making decisions but also that the degree of susceptibility is stronger in this group than among those who are only casually engaged in investing, i.e., students (Tables 2, 3 and 4). These findings are in line with earlier studies indicating that experts are susceptible to behavioral biases (Braun & Yaniv, 1992). Szyszka (2007) showed that a lack of understanding of the intricacies of finance and the capital market can, paradoxically, improve rationality of decisions. In his survey studies, students of fine arts and music were less susceptible to overconfidence and were more accurate in their estimates of the probability of market events than a group of stock market traders and educated investors.

Our results confirmed that the tendency to display behavioral biases is a highly automatized process, so both experts and amateurs in a given domain, and even laypeople, might be unaware of the influence these biases have on their decisions (Stephan, 1998). Moreover, there is little possibility of conscious control of these biases. Additionally, other research has shown that experts in various domains often show a strong tendency toward overconfidence when making critical decisions and sometimes intentionally use different rules of thumb to simplify the decision-making process (Roszkowski & Grable, 2005). Furthermore, Tetlock (2005) notes that, as a way of maintaining self-esteem and professional reputation, professionals are less capable of admitting to making mistakes and correcting them than laypeople. Finally, there is some evidence on the role of age differences in decision making under risk and uncertainty because these age differences could reflect other life experiences in addition to professional expertise. In particular, it was found that age may be negatively correlated with the ability to make optimal decisions under risk and uncertainty (Dror, Katoan & Mungur, 1998). Notably, age was not a statistically significant variable in our model, so the relative lack of rationality in decision making observed among the in-

vestors compared with the students may be attributed to other factors (e.g., expert overconfidence).

We observed greater venturesomeness and marginally higher impulsivity among the students than among the investors (Table 5). This finding may be the result of the students' youth relative to the investors' age. Moreover, we can assume that students have taken fewer risks with real money thus far in their lives than investors, who work with real cash. Therefore, for the typical student participant, our study was a purely hypothetical situation, which favored making more risky and impulsive decisions as has also been observed in other research (Garvey & Murphy, 2008).

Among the studied personality traits, only venturesomeness was statistically significant and influenced the rationality of the investors' decisions. A negative correlation was observed between venturesomeness and susceptibility to all the behavioral biases studied, i.e., the certainty effect, the sunk cost fallacy, and mental accounting (Tables 6, 7 and 8). In other words, in our sample, a higher level of venturesomeness was linked with a lower probability of behavioral biases.

To explain this result, we note that venturesomeness measures different aspects of risk-taking tendencies and is seen as a characteristic of people who are fully conscious of the risk they will take but have also fully decided to take it (Eysenck & Eysenck 1978). It has been noted that a high level of risk aversion among stock market investors is positively correlated with various behavioral biases (e.g., the attachment effect, see: Corter & Chen, 2006), or it results in too slow of a diversification of investment portfolios and reaction to changes in the capital market (Weller & Tikir, 2011). Additionally, some authors stressed that the higher the risk tolerance is among market investors, the more optimal and profitable their investment decisions are (Hopfensitz & Wranik, 2009; Sjoberg & Engelberg 2009; Sultana & Pardhasaradhi, 2010). However, positive correlations have been observed between venturesomeness, as measured with the IVE scale, and extraversion and openness to experience from the Big Five Model. These latter two traits predicted the effectiveness of investment fund management (Camgoz, Karan, & Ergeneli, 2011). Venturesomeness consists of self-confidence, self-efficacy, persistence in goal pursuit, and readiness to undertake risky behaviors and seek out new challenges while considering the possible

consequences of these behaviors (Eysenck & Eysenck, 2006). Although no studies to date have been conducted using the IVE scale in the context of the behavioral biases mentioned in this study, we suspect that the abovementioned components of venturesomeness can compose the personality profile of an effective and simultaneously rational market investor.

No statistically significant interaction effect was found in the logistic regression (Table 9), indicating that belonging to one of the two groups of participants (investors versus students) was not a moderator of the relationship between venturesomeness and the likelihood of making a rational decision in each of the three exercises in our questionnaire. In other words, this trait equally important for making rational decisions in each of the exercises. Perhaps this finding is a result of the homogenous nature of our sample (all of whom where market investors, differing only in terms of their professional/amateur status), and the nature of the relationships would differ if representatives of entirely different professions were included in the analysis.

This study did not support the significance of the other studied personality traits, impulsivity and empathy, on susceptibility or resistance to behavioral bias among investors (Tables 6, 7 and 8). Although the coefficients were statistically insignificant, the sign of the coefficients could be interpreted as suggestive evidence that individuals with the traits of impulsivity and empathy are more susceptible to all three of the biases. This interpretation could partially explain the fact that these personality types were under-represented in the sample (Mayfield et al., 2008). High impulsivity reflects a pathological aspect of risky behavior, an inability to control one's reactions, a disregard for social norms, and an inability to maintain long-term efforts (Eysenck & Eysenck, 2006) and is linked to various abnormal behaviors, such as gambling addiction (Mishra et al., 2010) and psychoactive substance abuse (Hayaki & Stein, 2006). We might suspect that people with this personality profile would not thrive in the difficult, cognitively complex and responsible profession of market investors, or if they did, they would likely be eliminated in the early stages of professional selection or would resign. However, people of high empathy, as measured with the IVE, are not only delicate and value close relationships with others but are also submissive, obedient, and conflict-

avoidant (Eysenck & Eysenck, 2006). Taking into consideration the high level of stress and competition in stock investing, we can again suppose that the abovementioned personality characteristics would not lead to success as a market investor (Benos, 1998).

In conclusion, a few limitations of this research should be noted. First, for the expert group, the average number of years investing at the stock exchange remains low (6.56), so the representativeness of this sample may be questioned. Second, including personality traits in financial analysis is difficult due to the problems with defining personality traits in financial terms. In particular, it is not altogether clear how the personality traits studied here are psychometrically linked to susceptibility to behavioral biases. We were also concerned with the choice of the personality questionnaire, which measures "cross-domain" risk-taking tendencies (impulsivity and venturesomeness). There is a question about whether we can extrapolate risky lifestyle activities (e.g., high-risk sports participation) to financial risk taking. Although an increasing number of studies use this methodology (Mishra et al., 2010; Sadi et al., 2011), their results vary, requiring further investigation.

5 Conclusions

Our paper provides new knowledge about the psychological determinants of decision making in the capital market. We not only confirm that pure experience does not help in making more rational investment decisions but also show that susceptibility to behavioral biases may depend on personality traits. Our results suggest the necessity of better educating investors to make them aware of potential psychological traps. However, we must remember that education does not guarantee success because personality traits may also determine one's attitude and behavior in a stock market.

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Appendix

Appendix 1. Exercise measuring susceptibility to the certainty effect

EXERCISE 1

Please imagine that you must choose between options A and B. *(Please circle the preferred option):*

- A. A lottery in which:
- You have an 80% probability of winning 4,000 PLN.
 - You have a 20% probability of not winning anything.
- B. A certain win of 3,000PLN.

Now, please choose between options C and D:

- C. A lottery in which you could win:
- 4,000 PLN with a probability of 20%.
 - Nothing, with a probability of 80%.
- D. A second lottery in which you could win:
- 3,000PLN with a probability of 25%.
 - Nothing, with a probability of 75%.

Appendix 2. Exercise measuring susceptibility to the sunk cost fallacy

EXERCISE 2

As the president of a large aviation company, you have invested 10 million dollars in a development project. Its goal was to build an airplane that would quickly cover the distance between Europe and the USA. When your project is 90% complete, a rival company announces that it is introducing an identical plane onto the market, which, as it turns out, is much more economical to use than yours. In this situation, would you invest the final 10% of the costs to complete the project (option A), or would you instead decide to immediately abandon it (option B)? *(Please circle the option you would choose).*

Appendix 3. Exercise measuring susceptibility to mental accounting

EXERCISE 3

Please imagine the following two situations, A and B, and circle the behavior that you would choose in each:

- A. You have decided to go see a movie, and you have bought a ticket for 20 PLN. After entering the cinema,

you discover that you have lost the ticket. You do, however, have a 20 PLN bill in your pocket. Do you spend another 20 PLN to buy another ticket, or do you decide not to see the movie?

- B. Now, please imagine that you have decided to go see a movie but have not yet bought a ticket. As you leave your home, you take two 20 PLN bills with you. After entering the cinema, you discover that you have lost 20 PLN. In this situation, do you spend the other 20 PLN to buy a ticket, or do you decide not to see the movie?

