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Influencing the Ostrich Effect: A research into the effects of stress and uncertainty on the Ostrich Effect.

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Abstract

The Ostrich Effect is a cognitive bias that causes people to avoid information which they could perceive as unpleasant. It has been reported in empirical studies that people check the value of their stock investment more often when the market is up than when the market is down. This paper tests this "ostrich" behavior in a real-incentivized lab setting with simulations of a stock market[1]. Two types of information are included in this design: 1) by a clicking a "value button", the subjects can learn about the real time value of their portfolio – which gives instant information on their investment; 2) by clicking a "information button", subjects can learn about the future trends of the stocks - which could be helpful for making future investments during the experiment. Contrary to the existing literature, this study finds no evidence for either type of information avoidance, i.e. the number of clicks of both buttons do not differ significantly when the market is up or down. Furthermore, this study designed randomized treatments to study the causal effect of the stress level of the decision maker and uncertainty of the information accuracy on information avoidance/seeking behavior. With a 2*2 treatment design (N=60), the stress treatment is comprised of a stress task before the stock simulation; the uncertain information treatment is executed by providing some inaccurate future information, along with some accurate ones, during the simulation. Several complications arose from the data collection: 1) high attrition rate and especially uneven attrition across treatment groups caused a selection effect; 2) lack of evidence for the effectiveness of the treatment task during the experiment: the uncertainty and stress treatment groups were not more uncertain or stressed than the control group. Non-parametric tests show no evidence for treatment effects but this is not conclusive due the reasons mentioned above. It is recommended for future research to alter the way participants will be influenced to be in an uncertain or stressed state of mind, shorten the length of the survey and only distribute the survey amongst experienced stock traders to increase both internal and external validity.

[1] I would like to thank Justin the Rooij for his contribution of helping me with creating the simulations and stress task that were used in the survey.

Introduction

Sticking your head in the sand. This type of behavior is commonly, incorrectly, associated with ostriches who, when feeling threatened or scared, are said to bury their heads in the sand. Though ostriches do not perform such behaviors in the wild, it has become abundantly clear through previous researches that humans do. In the financial markets for example, it was shown that people tended to avoid information when markets were down (Karlsson, Loewenstein & Seppi, 2009). This type of information avoidance was first dubbed 'the Ostrich Effect' in a paper by Galai & Sade (2006). To see whether this effect is influenced by certain external factors like stress and uncertainty, this research tries to answer the following research question:

'*Can stress and uncertainty affect the Ostrich Effect*'

Though many papers, like those from Karlsson, Loewenstein & Seppi (2009) and Galai & Sade (2006), found evidence for this Ostrich Effect, no studies have yet been done into the influence of external factors such as stress and uncertainty on the Ostrich Effect. By researching whether stress and uncertainty can influence the Ostrich Effect, this research is scientifically relevant.

This paper is also socially relevant for multiple reasons. Even though the Ostrich Effect can yield positive outcomes in the financial sector, like helping investors to avoid panic-selling when the market is down (Golman, Hagman & Loewenstein, 2017), the Ostrich Effect can also produce many negative outcomes. When avoiding information during a market downturn, for example, people could lose more money than necessary. An example of a negative outcome outside the financial sector could be with parents of children with chronic problems. These parents might not want to seek a definitive explanation of their child's condition because it would cause them psychological discomfort (Karlsson, Loewenstein & Seppi, 2009). Researching the influence of different external factors on the Ostrich Effect can yield insights that can be used to reduce the Ostrich effect to a minimum. Therefore, this research is also socially relevant.

A paper by de Berker et al. (2016) shows that stress responses are tuned to environmental uncertainty. Therefore, by increasing the amount of uncertainty, the more stressed people are expected to become. Next to this, Rosen & Knäuper (2009) showed that people were more prone to seek information when situational uncertainty was high. Combining these two findings, the first hypothesis is formulated:

'When exposed to uncertainty, people will seek information more often and the size Ostrich Effect will decrease'

In a paper by Vernon (1971) it was found that hospitalized tuberculosis patients who were taken care by uninformative physicians were more prone to seeking information about their illness compared to patients with informative physicians. These findings are consistent with the statement that people in a stressful situation will choose to use information if it is readily available and actively seek information when it is not. Following this finding, the second hypothesis is formulated:

‘When exposed to stress, people will seek more information and the size Ostrich Effect will decrease’

In a paper by van Zuuren & Wolfs (1991), it was shown that there are two ways of information seeking under threat. People who show signs of monitoring are more likely to seek information under stressful or threatening situations. People who show signs of blunting, however, are more likely to avoid information. The paper shows that the amount of monitoring increases with the perceived degree of threat and unpredictability. These findings lead to the third and last hypothesis:

‘When exposed to both stress and uncertainty, people will seek more information during the market downturn and the size ostrich effect will decrease’

In this paper, the way the survey was conducted will first be discussed. After this, the most important variables will be explained, summarized and analyzed. Then the results will show whether there is any evidence of the Ostrich Effect. Following these results, a statistical analysis will be done to see whether this Ostrich Effect can be influenced. Finally, some conclusions will be drawn from the findings in the result section and potential weaknesses and improvements to these weaknesses will be discussed.

Literature review

In this section, a deeper dive will be taken into the mechanics behind the Ostrich Effect. Some papers that were used for the creation of the survey (which will be further explained in the methodology section) will also be discussed.

The Ostrich Effect was first described in a paper by Galai & Sade (2006). This paper found that the yields to maturity were higher for government treasury bills compared to those of equally risky bank deposits. Following the reasoning of this paper, people are more prone to choose investments where the risks are unreported (bank deposits) compared to investments where the risks are reported (treasury bills). This phenomenon can be explained through the Ostrich Effect, which the paper describes, as the investors tendency to avoid risky financial situations by pretending they do not exist. Though this paper describes the Ostrich Effect more in terms of risk, the basic gist is still about the avoidance of unpleasant information.

The meaning of the Ostrich Effect was however slightly changed in a research by Karlsson, Loewenstein & Seppi (2009). This paper found that, when markets were down or flat (meaning not rising nor falling) investors monitored their portfolio's less frequently compared to when markets were rising. The researchers redefined the meaning of the Ostrich Effect to attribute the psychological discomfort of potential bad news as the main cause for people to avoid information instead of the uncertainty of risks. The paper by Karlsson, Loewenstein & Seppi (2009) used data collected over two and a half years. This research will however put the participant in a more realistic short term stock market situation. This way the participant will be more focused on the task at hand. In other words, the paper of Karlsson, Loewenstein & Seppi (2009) collected their data passively. Participants were doing many things next to checking their stock portfolio every so often during the two years in which the data was collected. This paper collects its data actively. Participants should be fully focused on the task at hand during the survey. Next to this the data used in the research of Karlsson, Loewenstein & Seppi (2009) only contained the amount of times participants checked the value of their portfolios. In this research, not only the amount of portfolio lookups will be looked for, but also the amount of times people actively gather information. Because gathering information will help the participant to increase their profits and looking at the value of a portfolio will not, there is a difference between the information gathering and checking the portfolio. This way, this research will contain two types of Ostrich Effects. The first Ostrich Effect (the voluntary Ostrich Effect) will be for the 'value button'; a button that is not necessary for the participant to click (it will not help participants to increase their profits). The second Ostrich Effect (the necessary Ostrich Effect) will be for the 'information button'; a button that is necessary for participants to generating more profit. Because active data collection and distinguishing between two types of Ostrich Effects, has never been done before in research on the Ostrich Effect, this adds to the scientific relevancy.

The Ostrich Effect is the result of information avoidance. This effect is hard to explain with standard Economic models however. This is because most of these models do not use information as a parameter within a person's utility function. Golman, Hagman & Loewenstein (2017) try to give reasons why people might be willing to avoid information in certain cases. This paper focusses only on 'active information avoidance'. Following the paper, people can display this active information avoidance behavior only when "(…) (1) the individual is aware that the information is available, and (2) the individual has free access to the information or would avoid the information even if access were free”. Because active information avoidance stands at the very foundation of the Ostrich Effect, the two assumption that were made in the paper of Golman, Hagman & Loewenstein (2017), will also be used in this paper.

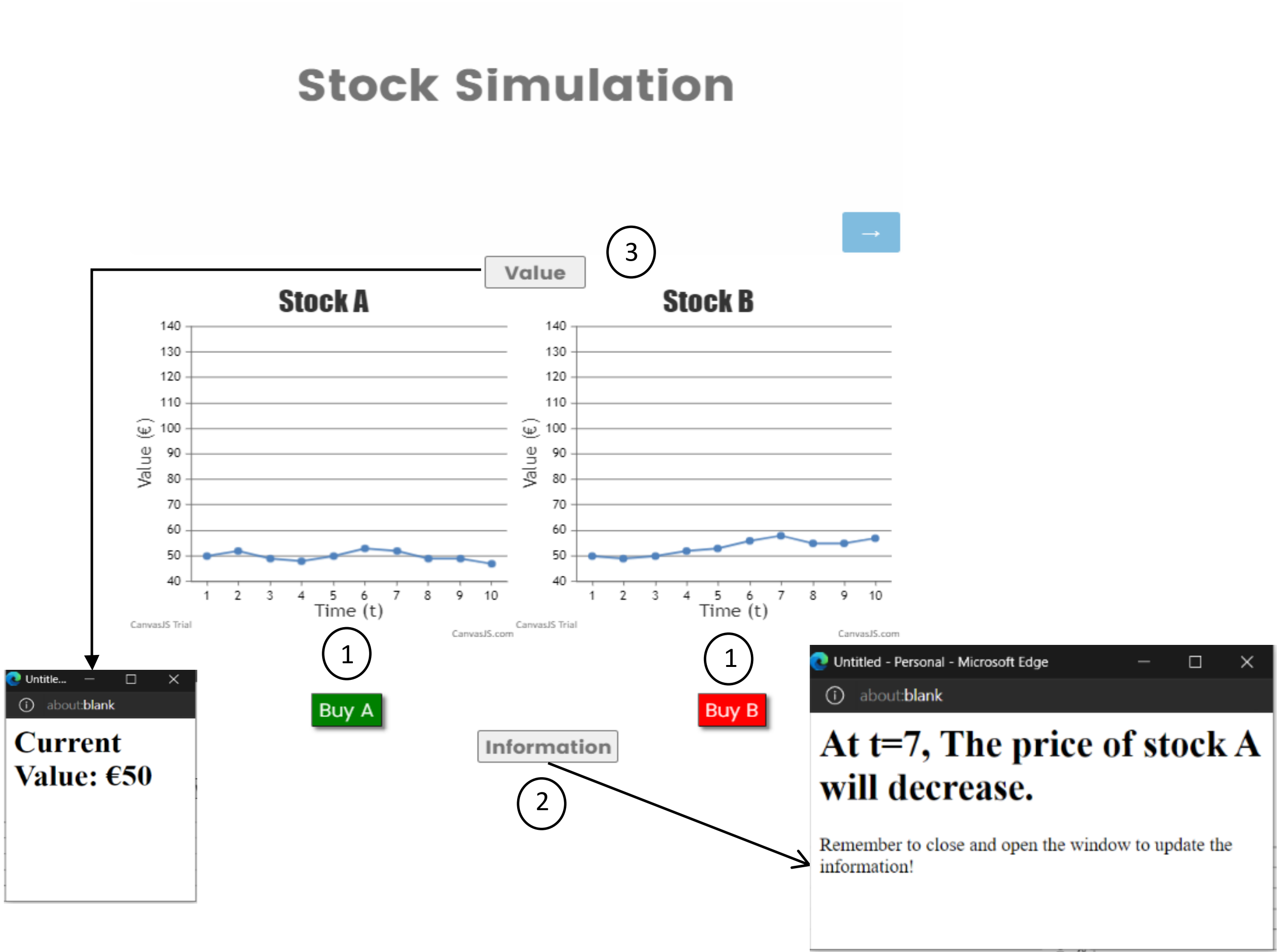
To measure the Ostrich Effect a survey with a stock simulation was created. An important paper into the creation of stock simulations was conducted by Vasarhelyi (1981). This paper stated that financial incentives help to increase the commitment and effort of participants in stock simulations. Another important finding was that individuals tended to change their attitude and strategies during the experiments. To account for these findings, the stock simulation in this paper will contain financial incentives and the results will be controlled for changes in behavior over time.

Methodology

Experimental Design

To test how the Ostrich Effect might change under stress and uncertainty, a survey was created using Qualtrics. In this survey, people were presented with simulations of two types of stocks (Stock A and Stock B) that fluctuated between two prices. After giving their consents to participate the experiment, the participants are presented with an instruction page on how the simulations worked. Participants were incentivized to generate as much profit as possible by buying and selling the stocks. After the instruction, participants were presented with a practice round to get accustomed to the lay out of the simulation.

Figure 1: The stock simulation



Notes: This figure shows the lay-out of the stock simulation. When clicking the information and value button, a pop-up screen appeared with information. The value button shows the value of the participant's portfolio at the point when the participant presses the button. The information button provides a participant with information of how the price is about to change for a certain stock.

Figure 1 shows the stock simulation used in the experiment. Participants started off with €50 in Stock A and could choose to buy either Stock A or B. For simplicity sake, the entire value of a participant's portfolio must be invested in only one stock at a time. This means that participants could not split their money between the two stocks, nor could participants choose to not invest in a stock at all.

The simulation interface contained 4 buttons. Therefore, participants could perform four actions during the simulation. The first two buttons, 'Buy A' and 'Buy B' (represented with the number '1' in figure 1), were used for people to put the value of their entire portfolio in either Stock A (with the Buy A button) or Stock B (with the Buy B button). When a participant bought a certain stock the buy button of that stock turned green to indicate that a person actually bought that stock.

The 'Information' button (represented with the number '2' in figure 1) gave people access to market information. This information helped participants anticipate whether the stocks would rise or fall. The information given by the information button would show up 5 data points before an event actually happened and would disappear 2 data points after the event happened. When, for example, stock A would rise at T=8 the information button would display that 'The price of stock A will rise at t=8' from t=3 until t=10.[2] Each simulation gave 8 different information messages. This means that it was possible for a participant to not receive any information at all after clicking the information button. It was also possible for a participant to receive two information messages at the same time.

Finally, participants could check the value of their portfolio by clicking on the 'Value' button (represented with number '3' in figure 1). The value of the portfolio and the market information were both hidden behind pop-up screens. This means that participants had to actively click the 'Value' and 'Information' buttons before having access to this information. Seeking information could therefore be measured by the amount of times participants clicked these buttons. Participants were also informed of the fact that these two buttons gave information. Because the information was also free, the two assumptions of active information avoidance were met and participants were therefore able to display types of behaviors in line with active information avoidance. All buttons could be pressed as many times as the participant wished during the simulation. Because the information in both buttons only updated when the pop-up screens were refreshed, the participants were reminded to close their pop-up screen and press the button again for new information.

Each simulation lasted around 2 minutes with the data points (like the prices of the stocks and the information within the value and information button) updated every 1.8 seconds. These relatively quick changes of stock prices were made to simulate a real stock market. This means that people did not have much time to react to changes in price and therefore had to change their investment strategy in real time (like real stock traders also do). Like in a real market situation, the participants were mostly uncertain of where the stocks were heading. The survey contained one practice simulation and three simulations where data was collected (the so-called 'real' simulations). The 'real' simulations contained

[2] Note that in figure 1, the information button was pressed at t=9. If the pop-up screen would be closed and opened again at the time that the screen shot was made (t=10), other information would appear.

a total of 72 data points. These data points were divided into four periods of 18 data points, where two periods had increasing stock prices and two periods had decreasing stock prices. The practice simulation was a bit shorter and only contained 18 data points. In total the survey lasted around 12 minutes. It was chosen to include three simulations in the survey to increase the amount of observations per participant and control for possible learning effects.

The simulations were created in such a way that the prices of both stocks were positively correlated. In other words, if there was a positive trend in the price of Stock A, there would be a positive trend in the price of Stock B as well. Some random deviations were put in as to not make the stocks completely the same and allow participants to generate some profit. All participants received the same simulation. The way in which the prices of the stocks developed, therefore, was exactly the same for every participant. This way the results could be more easily compared.

To incentivize participants to pay close attention to what they were doing during the simulation, one participant was randomly chosen to win the highest profit that they earned during all simulations. To further incentivize participants, the profit made after a simulation was completed was shown. This way, participants were aware of what profit they could make and more incentivized to increase commitment and effort during the simulations (Vasarhelyi, 1981). Because the incentives cause people to pay more attention to what they are doing during the simulation, the behavior of the participants becomes more convincing and closer to how they would act in the real world.

Treatment Design: Influencing the Ostrich Effect

Because the simulations are split up into different periods, where some periods have rising stock market prices and some periods declining stock prices, it is easy to measure (clicking) behavior under different market conditions. By comparing how many times people check their portfolios and the information button between periods when market climb and periods where markets fall, it is possible to measure the Ostrich Effect.

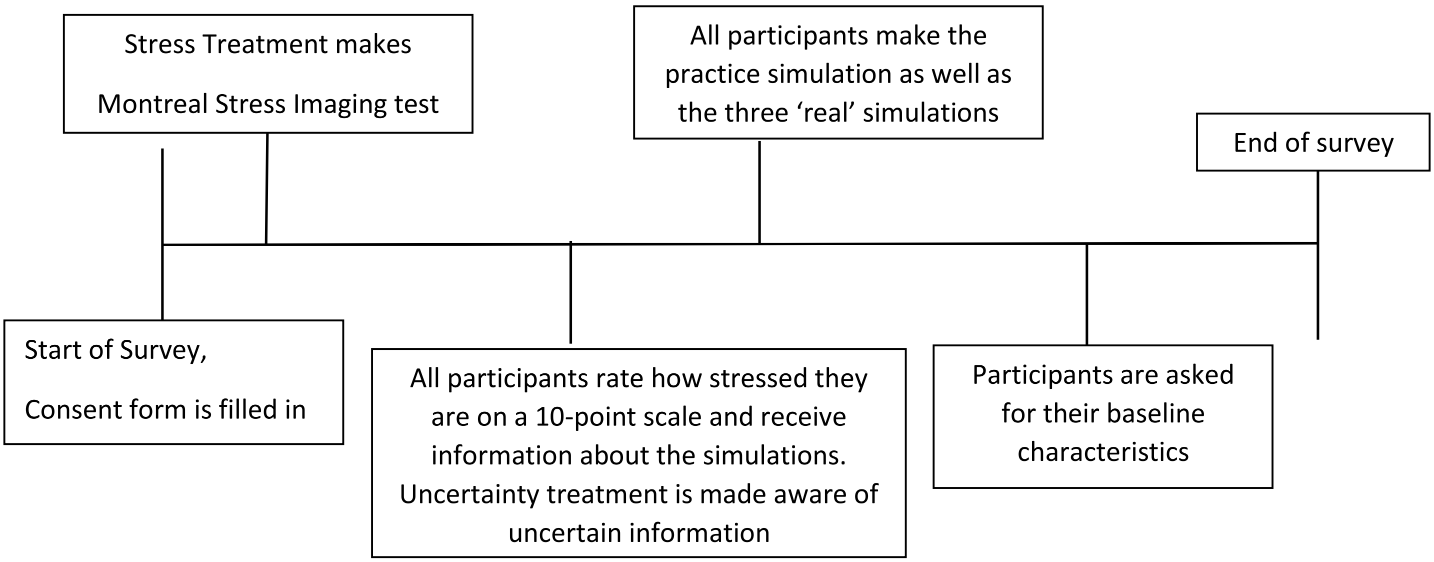
To see whether stress and uncertainty have any impact on the amount of times participants check the value of their portfolio's, three treatment groups and a control group were formed to create a two by two factorial design. The first treatment group was influenced to be in a stressed state, before heading into the stock simulation. This was done by making participants perform a version of the Montreal imaging stress task (Dedovic et al., 2005). In this test, people had to perform mental arithmetic under a time control. This test has been proven to be effective and efficient for getting people in a stressed state. In contrast to the original stress task by Dedovic et al. (2005), participants could enter their answers to the arithmetic question by pressing a number on their keyboard. In the original stress task a wheel of numbers was used to scroll through and people had more room to make mistakes. Unlike the original test, the task also ended when participant got three questions incorrect. These modifications resulted in the task being a bit shorter than the original while making it a bit more stressful by decreasing the error margins. Like the original task, however, people received negative feedback after answering a question incorrect. People received an indication of how many correct answers 'the average person' should have, which was way above the amount of correct answers a real average person could obtain. This way an unrealistic standard was created. Finally, like the Montreal imaging stress task, time decreased and difficulty increased with the amount of correctly answered questions, to increase the pressure.

The second treatment group had to deal with uncertainty. This was done by giving people information during the simulation that did not always fully correlate with the movements of the prices of the stocks. The participants were informed that they would receive information that would not always be correct. More concretely, some of the (market)information given during the simulation was not accurate. People might for example have gotten the information that Stock B would rise at T=7, while in reality the price of the stock decreased.

The third treatment group both had to make the Montreal imaging stress task and received the inaccurate information. Finally, the control group did not make the stress test and received completely accurate information.

Before the simulation, all participants had to rate how stressed they were at that point in time on a ten-point scale. This manipulation check was used to see whether participants that received the stress treatment were actually more stressed than those who did not. A similar treatment check was automatically put into place for the uncertainty treatment. The clicking behavior of the information button can be compared between participants who received the uncertainty treatment and participants who did not, to see whether this treatment had any effect. To complete the survey, people were asked for their age, gender and occupation as baseline controls. Figure 2 displays a timeline of the survey as discussed in this section.

Figure 2: Timeline of the survey



Variables & Data Collection

There are two main outcome/dependent variables. The first variable will contain the amount of times participants looked up the value of their portfolio's when the market was rising minus the amount of times participants looked up the value of their portfolio's when the market in decline. This variable is named *Ostrich Value* and it will say something about the 'voluntary' Ostrich Effect, like previously mentioned. The second variable will contain the amount of times participants clicked the information button when the market was rising minus the amount of times participants clicked the information button when the market in decline. This variable is named *Ostrich Information* and it will say something about the 'necessary' Ostrich Effect. These two variables are a good representation of the Ostrich Effect. A rational participant would not change the amount of times they click the value or information button depending on whether the stocks are rising or falling. Following the theory of the Ostrich Effect, it is expected that a not fully rational participant clicks the information and value buttons more times during periods when markets rise compared to periods where markets fall. Therefore, the variables *Ostrich Value* and *Ostrich Information* are expected to be positive.

The main independent variables are the treatment variables *Uncertainty Treatment, Stress Treatment* and *Uncertainty and Stress Treatment*. These binary variables will be 1 if a participant received a certain treatment and 0 if not. If a participant for example received the uncertainty treatment but not the stress treatment the variable *Uncertainty Treatment* would equal 1 and the variable *Stress Treatment* would equal 0.

Lastly some control variables will be used. The control questions included *Gender, Age Category, Occupation,* whether people traded in *Stocks*. The variable *Simulation* was also created. The categorical variable *Gender* contains the groups Male, Female and prefer not to say and is indicated by 0, 1 and 2 respectively. The categorical variable *Age Category* contains the groups 0-17, 18-25, 26-39, 40-64 and 65+ indicated by 0,1,2,3 and 4 respectively. The categorical variable *Occupation* contains the groups Student, Employed, Unemployed and Other and are indicated by 0,1,2 and 3 respectively. The binary variable *Stocks* is equal to 1 if a participant never traded in stocks before and 0 if the participant did trade in stocks before. Lastly the categorical variable *Simulation* indicates which of the three simulations a participant is in (simulation 1, simulation 2 or simulation 3) and equals either 1,2 or 3. This last variable will not be put into the summary statistics because this variable on its own does not tell us something interesting (each participant that fully completed the survey made the first, second and third simulation).

Summary Statistics

Table 1: Summary Statistics

Variables	Mean	Standard deviation
Gender		
Male	0.891	0.315
Female	0.109	0.315
Prefer not to say	0	0
Age Category		
0-17	0.036	0.189
18-25	0.836	0.373
26-39	0.036	0.189
40-64	0.091	0.290
65+	0	0
Occupation	0.745	0.440
Student		

Employed	0.145	0.356
Unemployed	0.073	0.262
Other	0.036	0.189
Stocks	0.600	0.494
Observations	55	

Notes: This table displays the means and standard deviations of the control variables used in the upcoming regressions. All means are displayed as proportions.

When analyzing table 1 and summarizing the sample of the survey, the following things are important to note. When looking at the *gender* variable, it becomes apparent that the majority of participants were males. The same becomes clear when looking both at the *Age Category* and *Occupation* variables. The vast majority of participants were students in the 18-25 age category. Lastly a small majority of people have never traded in stocks before. When looking at attrition, however, a problem arises.

Attrition

Out of the 119 participants that started the survey, only 55 managed to complete the entire survey and 60 participants completed one simulation or more. If the amount of completed simulations is influenced by the treatment a participant received, there would be a serious selection bias. To see whether this bias exists, a variable *attrition* is created. This variable equals 0 if a participant complete zero of the three 'real' simulations, 1 if a participants completed one simulation etc.

Table 2: Summary of the variable *Attrition*

Amount of simulations completed	Number of participants
0	58
1	6
2	1
3	53
Total	118

Notes: This table displays the amount simulations each participant made during the survey.

Table 2 shows that a majority of people did not complete any simulations. This could be due to the fact that the simulations were too difficult, the information given to the participants was too unclear or the simulation itself lasted too long. Using a Shapiro-Wilk W test, it is found that the variable *attrition* is normally distributed (p=0.755). Next to this a Bartlett's test to check for equal variances was conducted.

This test showed that the variances of the treatment groups were equal (p=0.366). This means that a one-way Anova test can be conducted to see whether there are any significant differences in attrition between the different types of treatment groups. The test showed that there was a significant effect of the treatment group type on the variable *Attrition* at a significance level of p<0.01 under the three conditions [F (3,114) = 6.04, p=0.0007].

Table 3: Attrition rate per treatment group

Treatment group	Sample size before exclusion	Sample size after exclusion	Completion of 1 simulation or more	p-value compared to control
Control	47	18	38.2%	-
Stress	31	12	38.7%	0.845
Uncertainty	21	19	90.0%	0.000
Stress and uncertainty	19	11	57.9%	0.240

Notes: This table displays the attrition rate per treatment group. The completion variable given in this table displays the percentage of participants that completed one simulation or more during the experiment. The p-values displayed in this graph were calculated using t-tests which compare the amount of completed simulations between control and treatment groups (using the attrition variable).

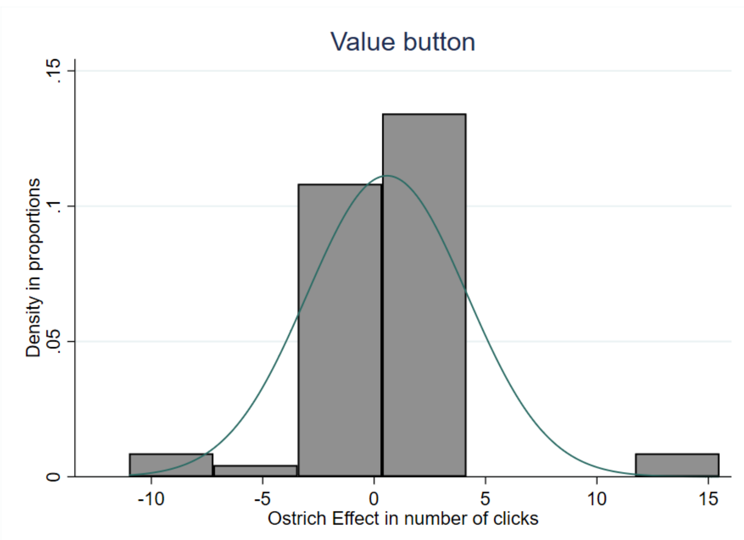
This is cause for concern because there is a significant selection effect (the amount of simulations a participant completes is dependent on the treatment group. Table 3 further supports the results of the ANOVA test by finding a significant difference between the completion percentage of the control and uncertainty treatment group. The uncertainty treatment group had a significantly higher percentage of completion (or lower attrition) compared to the treatment group. This result is a bit puzzling, because the length of the survey was not different between uncertainty treatment and the control group. Because the stress treatment and the stress and uncertainty treatment group had to perform an extra task (with the Montreal Stress Imaging task), the survey lengths of these two groups were longer. These two treatment groups, however, did not have a significantly different attrition rate compared to the control group. Therefore, the attrition does not depend on the length of the survey.

To counter the selection effect, only the participants that completed the first simulation (a total of 53+1+6=60) will be looked at during the analysis.

Analysis

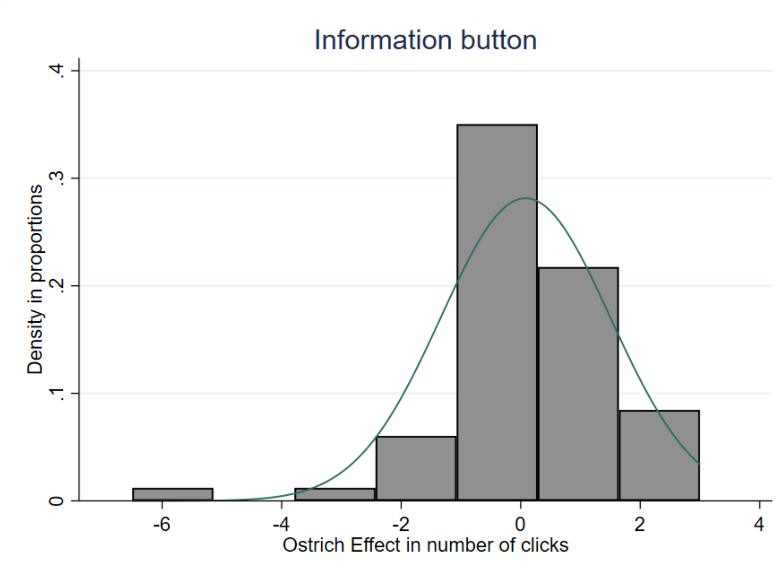
To see what kind of analysis fits best with this research, the two main dependent variables *Ostrich Value* and *Ostrich Information* will have to be looked at. Like previously mentioned, it was chosen to analyze two different buttons. The information button gave participants information which was helpful in knowing where the price of the stocks was heading. The information contained within the information button was helpful for participants to increase their profits. The value button on the other hand did not have this property. Though participants could know the value of their portfolio during the simulation, it was not necessary to click this button nor did it give participants the chance to increase their profits. The most important thing to look for, is whether these variables are normally distributed.

Figure 3: Histogram of the distribution of the variable *Ostrich Value*



Notes: This figure displays the variable *Ostrich Value* on the x-axis and the density of the amount of observations of this variable on the y-axis. The line represents the normal distribution that was best fitted through the histogram.

Figure 4: Histogram of the distribution of the variable *Ostrich Information*



Notes: This figure displays the variable *Ostrich Information* on the x-axis and the density of the amount of observations of this variable on the y-axis. The line represents the normal distribution that was best fitted through the histogram.

Both in figure 3 and 4 the normal distributions that were fitted through the histograms do not really fit well. To test whether there is statistical evidence to show that these variables are not normally distributed, two Shapiro-Wilk W test were performed. The Shapiro-Wilk W showed statistical evidence that the ostrich effect for both the information and value buttons were not normally distributed (both p-values were smaller than 0.01). This means that the analysis will have to use non-parametric tests to find statistical evidence for whether uncertainty and stress can affect the Ostrich Effect.

Results

The ostrich effect

Before looking whether the Ostrich Effect can be influenced by stress or uncertain information, the Ostrich Effect itself must first be observed. To see whether participants display behavior in line with the theory behind the Ostrich Effect, the frequency with which participants press the value and information button during market upswings compared to market downturns will be looked at. By creating the variables *Ostrich Value* and *Ostrich Information*, the Ostrich effect can be measured, both with the value button and information button respectively. These variables are the aforementioned main outcome variables. The variables contain the difference in frequency of clicks when the market simulation was up minus the frequency of clicks when the market simulation was down. To put it into a formula it would follow:

$$Ostrich\,Value = number\ of\ value\ button\ click\ during\ market\ upswing \\ - number\ of\ value\ button\ click\ during\ market\ downturn$$

The same would count for the information button (or *Ostrich Information*). Because the data collected in the second and third simulation was discarded because of the selection effects, only two observations remain per individual per button. For the analysis, an average will be taken of these two observations both for the variable *Ostrich Value* and *Ostrich Information*.

Because the Ostrich Effects predicts people to search less information during market downturns, it is expected that the *Ostrich Value* and *Ostrich Information* variables will both be positive. To test whether there is any evidence of a positive Ostrich Effect, a non-parametric sign test is performed. This sign test will only be performed on the subset of participants that neither received the stress nor uncertain information treatment (the control group).

Table 4: Results sign test

Variables	Observed	Expected	P-value
Ostrich Value			0.696
Positive	7	7.5	
Negative	8	7.5	
Zero	3	3	
Combined	18	18	
Ostrich Information			0.151
Positive	10	7.5	
Negative	5	7.5	
Zero	3	3	
Combined	18	18	

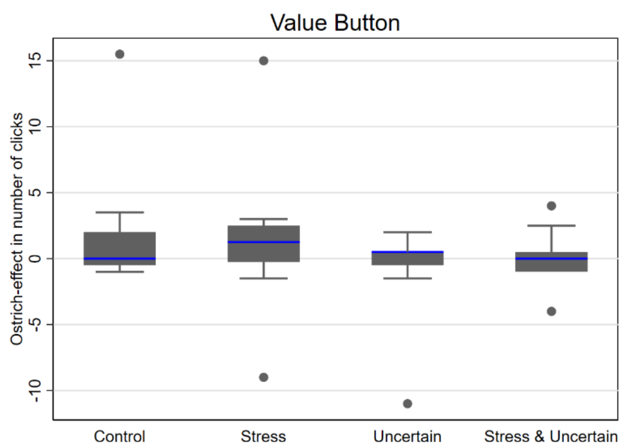
Notes: This table displays the results of the sign test performed on the *Ostrich Value* and *Ostrich Information* variables. The p-value of the value button is calculated with the binominal distribution (n=15, x>=7, p=0.5). The p-value of the information button is given with the binominal distribution (n=15, x>=10, p=0.5).

The results of table 4 show that participants in there is no significant statistical evidence to say that the *Ostrich Value* and *Ostrich Information* variables are positive. Therefore, there is no evidence to the existence of the voluntary Ostrich Effect (of the value button) nor the necessary Ostrich Effect (of the information button). The control group did not display behavior in line with the Ostrich Effect.

Treatment Effect

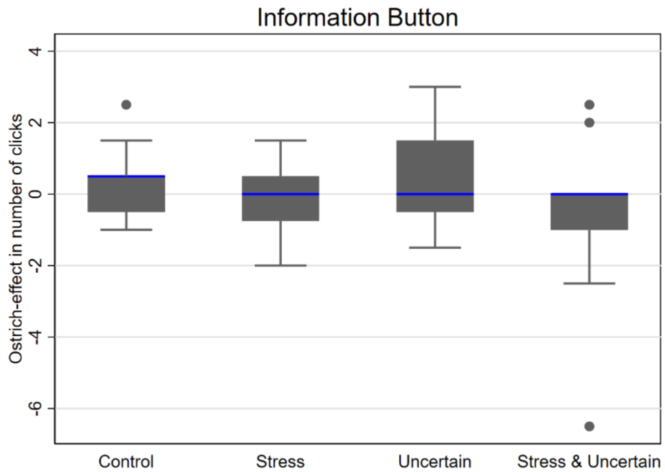
Although the previous section did not yield any significant Ostrich Effects, it is still interesting to look whether the different treatments can yield significant effects. Before looking whether the treatments can cause any significant Ostrich Effects, the *Ostrich Value* and *Ostrich Information* variables will be looked at a bit closer.

Figure 5: Box-plot of the variable *Ostrich Value* per treatment type



Notes: This figure displays the box plot of the variable *Ostrich Value* per treatment type. The box from the boxplot is drawn from the first until the third quartile of the variable. The blue line through the boxplot shows the median. The whiskers show the upper and lower adjacent values (values that are furthest away from the median but still in 1.5 times the distance of the interquartile range) of the variable and the dots represent outliers. The outliers are not excluded in the calculation of the means, medians and interquartile ranges.
Control group: Mean=1.25, Standard Deviation=3.82, Median=0, Interquartile range=2.5.
Stress Treatment group: Mean=1.38, Standard Deviation=5.34, Median=1.25, Interquartile range=2.75.
Uncertainty Treatment group: Mean=-0.29, Standard Deviation=2.75, Median=0.5, Interquartile range=1.
Stress and uncertainty treatment group: Mean=0.09, Standard Deviation=2.03, Median=0, Interquartile range= 1.5.

Figure 6: Box-plot of the variable *Ostrich Information* per treatment type



Notes: This figure displays the box plot of the variable *Ostrich Information* per treatment type. The box from the boxplot is drawn from the first until the third quartile of the variable. The blue line through the boxplot shows the median. The whiskers show the upper and lower adjacent values (values that are furthest away from the median but still in 1.5 times the distance of the interquartile range) of the variable and the dots represent outliers. The outliers are not excluded in the calculation of the means, medians and interquartile ranges.
Control group: Mean=0.31, Standard Deviation=0.88, Median=0.5, Interquartile range=1.
Stress Treatment group: Mean=0.08, Standard Deviation=1.06, Median=0, Interquartile range=1.25.
Uncertainty Treatment group: Mean= 0.42, Standard Deviation=1.27, Median=0, Interquartile range=2.
Stress and uncertainty treatment group: Mean=-0.64, Standard Deviation=2.38, Median=0, Interquartile range=1.

In figure 5 and 6 the medians of both the *Ostrich Value* and *Ostrich Information* are mostly centered around zero. The outliers, as seen in figure 4 and 5, will be used in the non-parametric statistical tests. Though it is hard to see whether there are significant differences in the two main dependent variables through the box plots alone, these differences can become clear using non-parametric statistical tests. To test whether uncertainty and stress can affect the Ostrich Effect of the value and information buttons, separate Mann-Whitney U tests will be performed. Each test will run a different type of treatment against the control for both the value and information button.

Table 5: Results Mann-Whitney U test for the Value button

Notes: This table shows the results of the Mann-Whitney U tests for the value button. Each treatment group is measured against the control group. The table displays the amount of observations, the ranked sum of the *Ostrich Value* variable for each treatment group, the expected ranked sum of each treatment group, the adjusted variance and the p-value.

Ranked sum Whitney U test					
	N	Rank sum	Expected	Adjusted variance	P-value
Control	18	262.5	279	551.54	0.482
Stress Treatment	12	202.5	186		
Combined	30	465	465		
Control	18	344.5	342	1060	0.939
Uncertainty Treatment	19	358.5	361		
Combined	37	703	703		
Control	18	279	270	482.8	0.682
Stress & Uncertainty Treatment	11	156	165		
Combined	29	435	435		

When looking at the results of table 4, the following becomes clear. For the value button (or the variable *Ostrich Value*) there is no significant difference between the control and stress treatment group. Therefore, the first hypothesis 'When exposed to uncertainty, people will seek information more often and the size ostrich effect will decrease' is disproven for the value button. The same counts for the uncertainty treatment. There is no statistical evidence to prove that the Ostrich Effect for the uncertainty treatment group is different from the control group. This disproves the second hypothesis, which stated that 'When exposed to stress, people will seek more information and the size ostrich effect will decrease'. Finally, the group that received both treatment also does not have a significantly different *Ostrich Value* compared to the control group. The third and last hypothesis 'When exposed to both stress and uncertainty, people will seek more information during the market downturn and the size ostrich effect will decrease' is therefore disproven as well.

Table 6: Results Mann-Whitney U test for the Information Button

Ranked sum Whitney U test					
	N	Rank sum	Expexted	Adjusted variance	P-value
Control	18	296.5	279	534.8	0.449
Stress Treatment	12	168.5	186		
Combined	30	465	465		
Control	18	343.5	342	1053	0.963
Uncertainty Treatment	19	359.5	361		
Combined	37	703	703		
Control	18	303	270	481.2	0.133
Stress & Uncertainty Treatment	11	132	165		
Combined	29	435	435		

Notes: This table shows the results of the Mann-Whitney U tests for the value button. Each treatment group is measured against the control group. The table displays the amount of observations, the ranked sum of the *Ostrich Information* variable for each treatment group, the expected ranked sum of each treatment group, the adjusted variance and the p-value.

Like with table 4, again there are no statistically significant differences between the different treatment groups and the control group. Therefore, all three hypotheses are disproven for the information button as well.

Treatment Checks

To see whether the treatments that were put into the survey actually had the desired effect, treatment checks were put into the survey. The first treatment check checked whether people that received the stress treatment were on average more stressed than the people that did not receive any stress treatment at all. The participants who received the stress treatment are therefore expected to have a higher average stress score that the participants that did not receive the stress treatment. The second treatment check checked whether people that received the uncertainty treatment pressed the information less compared to the people that did not receive the uncertainty treatment. It is expected that participants that received the uncertainty treatment press the information button less on average compared to the participants who did not get the uncertainty treatment.

To test whether both treatments had the desired effect, two two-way t-tests will be performed to see whether the desired differences between treatment and control groups are (significantly) visible.

Table 7: Results two-way t-test on stress level categorized by stress treatment after the first stress check

Variables	N	Mean	Standard Error	t	p-value
No stress Treatment	69	4.942	34.030		
Stress treatment	50	4.740	36.414		
Difference		0.202	0.540	0.374	0.709

Notes: This table displays the results of the two-way t-test performed on the *stress level*, which participants rated on a scale from 0 (not stressed at all) to 10 (most stressed). The p-values that are displayed are tested against the h_a (alternative hypothesis), that the difference between the two variables is not 0. *** p<0.01, ** p<0.05, * p<0.1

When looking at the results of the stress treatment, again no significant differences are found between the treatment and control group. This can be explained in two ways. Either the treatment was ineffective or the scale (from 0 to 10) that people used to rate how stressed they were could not accurately represent how stressed the participants were in real life. Following Ockham's Razor, which states that the simplest explanation is most often the correct one, the treatment was probably ineffective. Participants were asked twice to rate their stress levels. Once at the very beginning of the survey for participants that did not receive the stress treatment and right after the stress test for participants who did receive the stress treatment, and once after the simulations. Because participants were asked to rate their stress level immediately after the stress test, it was expected that their stress levels would be higher than those who were in the control group. However, no significant difference is found after the first stress check as displayed in table 7. The second stress check yielded the same conclusion, there were no differences.

Table 8: Results two-way t-test on the amount of times that the information button was clicked categorized by uncertainty treatment.

Variables	N	Mean	Standard Error	t	p-value
No uncertainty Treatment	18	21.278	15.241		
Uncertainty treatment	19	32.053	24.061		
Difference		-10.775	28.84	-0.374	0.711

Notes: This table displays the results of the two-way t-test performed on the amount of times that the information button was pressed during the survey between the control and uncertainty treatment group. The p-values that are displayed are tested against the h_a (alternative hypothesis), that the difference between the two variables is not 0. *** p<0.01, ** p<0.05, * p<0.1

Looking at the uncertainty treatment first, table 8 shows no significant difference in number of clicks on the information button between the participants who received the uncertainty treatment and the participants who did not receive this treatment during the first simulation. This insignificant difference could be explained in a few ways. First, the amount of clicks on the information button is not indicative of the fact whether a person is aware of the uncertain information. To put it simply, people could be aware that some of the information displayed during the simulation is incorrect and still decide to press the information button anyway. Second, because clicking behavior is different between participants (some people click the information button 5 times during a simulation, other people press it 50 times), the law of large numbers has not 'kicked into gear' yet. There is a relatively small number of participants and the participants have very different clicking behaviors. This is reflected in the high standard errors. This could be a valid explanation of why there is no significant difference between the treatment and control group. Lastly, the treatment manipulation could have been ineffective. In this case, the survey would have not make it clear enough, or people were just unaware of the fact that the group that received the uncertainty treatment was given uncertain information during the survey.

The number of participants that are used in the stress treatment check is higher than the number of participants in the uncertainty treatment. This discrepancy is caused because not every participant managed to complete the entire survey. A total of 119 participants filled in how stressed they were at the beginning of the survey, but only 60 participants completed one simulation or more (of which 18 were in the control group and 19 in the uncertainty treatment group). If the stress treatment check is solely run on the 60 participants who managed to complete one simulation or more, there are still no significant differences between stress levels of the stress treatment and control group.

Conclusion

In this research, it was looked at if the Ostrich Effect could be influenced by certain external factors like stress and uncertainty. This was done to see whether the Ostrich Effect, which can be seen as negative and irrational type of behavior, could be reduced. Reducing the Ostrich Effect would help stock traders be more vigilant, even when markets are down, and bypass losses that would otherwise have been made under the consequences of the Ostrich Effect.

Following the results of the stock simulation in the survey that was specially created for this research, no significant statistical evidence was found for the existence of the Ostrich Effect. This was true for both the ‘voluntary’ Ostrich Effect (or the effect of the value button) and the ‘necessary’ Ostrich Effect (or the effect of the information button). This is in conflict with previous literature, like the research of Karlsson, Loewenstein & Seppi (2009). The non-parametric sign test did not show that participants in the survey were less likely to search for information during market downturns compared to when the market was rising.

When exposed to uncertainty, both in the case of the value and information button, there was not enough statistical evidence to conclude that the Ostrich Effect could be influenced significantly. This conflicts with the literature of de Berker et al. (2016) and Rosen & Knäuper (2009). The first hypothesis ‘When exposed to uncertainty, people will seek information more often and the size ostrich effect will decrease’ therefore, does not hold neither for the value nor for the information button.

After inducing people half of the participants to become stressed, using an altered version of the Montreal imaging stress task (Dedovic et al., 2005), the following was concluded. When looking at the clicking behavior of the value and information button, no significant effect could be found. This is in contrast with the literature of Vernon (1971) and the second hypothesis ‘When exposed to stress, people will seek more information and the size ostrich effect will decrease’.

The last hypothesis ‘When exposed to both stress and uncertainty, people will seek more information during the market downturn and the size ostrich effect will decrease’ was also disproven. When looking at the information and value buttons, the Ostrich Effect was not significantly influenced when a group was induced with both stress and uncertainty compared to the control group. Therefore, the results of this survey are also in contrast with the literature of van Zuuren & Wolfs (1991).

Looking at the treatment checks, it became clear that the treatments did not live up to the standard. Both treatment checks concluded that there were no statistically significant differences between the treatment and control group. This is a problem because the treatments might have not worked properly. People might not have gotten stressed enough from the stress treatment, or people might not have fully realized that their simulation contained uncertain information. On the other hand, the sample size might have been too small to find statistically significant differences (which could have especially been the case for the uncertainty treatment).

When taking a step back and looking at the research question '*Can stress and uncertainty affect the Ostrich Effect*' it must be concluded that this research provides no evidence to say that it can. Neither significant Ostrich Effects were found, nor significant differences between the control and treatment groups. Therefore, with the results and statistical analysis of the survey in mind, this paper concludes that the Ostrich Effect cannot be influenced by stress, uncertainty or a combination of the two in the current setting.

Discussion

Different conclusions, however, might be drawn when altering the survey. The two main problems of the way that the survey was conducted were the two treatment. Both were proven to be ineffective when looking at the behavior of the participants. In a future research, one might consider to expand the stress test. The altered version of the Montreal imaging stress task (Dedovic et al., 2005) might have been simplified too much, which would have resulted in the task to be ineffective at inducing stress to participants. By copying the test completely, results might be different and a significant decrease of the Ostrich Effect could be backed up by a correct treatment check. This way, one could be certain that this decrease of the Ostrich Effect would be caused by the treatment. This was not the case in this research.

For the uncertainty treatment, it might have been useful to make it extra clear that participants who received the uncertainty treatment received uncertain information. Though the sample used for the treatment check contained participants with very different clicking behavior (indicated by the large standard errors), it might have not been clear enough that people received uncertain information. For a future research, the introduction to the simulations might have to mention more times that the information given could be false. An alternative solution would be to induce uncertainty in another way outside of the simulation (like the stress task was supposed to do).

After looking at the survey data a few extra things could be improved. Only 53 of the 118 participants that received the survey finished the survey to the end (and completed all simulations). That is 55 percent of participants who stopped after seeing the information to the first simulation, after making the practice simulation or the first two simulations itself. This might imply that either the survey was too long, or people might not have been interested in making the survey. Though putting four simulations in the survey would have yielded six useable observations for every single participant, the survey was fairly long. For a future research it might be useful to drop one of the simulations to shorten the length of the survey and increase the percentage of people completing the survey.

The selection bias was a big problem too. Because of this effect, two of the three simulation had to be dropped. Because it was unclear what caused the selection bias to occur, it is also difficult to find a solution to this problem. It might help to incentives participants more to complete all the simulations within the survey for a future research. This way, by lowering the attrition rate, the selection effect could disappear.

The simulation part of the survey was also difficult to understand for some people. For many participants the idea of trading stocks was foreign and therefore pretty difficult to understand. Though it was tried to give participants all the information needed and even give them a practice simulation to get accustomed to the survey itself, it might not have been enough to fully inform the participants. One might consider only handing the survey out to experienced stock traders for a future research. This is for two reasons. First, stock traders should generally have a better understanding of how these simulations work compared to people who have never traded in stocks before. Second, the Ostrich Effect is an effect that is commonly observed under stock traders. By restricting the sample to solely observe the behavior of stock traders, this would benefit both the internal and external validity of the research. The internal validity would increase because the simulations would be made in the way that they were intended. This is in contrast to people who are not accustomed to trading and who just pressed the buttons randomly during the simulation. The external validity would increase because the results of the research could better be reflected on the real world. The sample in the survey would be the same as the traders in the real world. Because many of the participants were not familiar with trading stocks, the external validity of this research is less than what it would be if the survey would only contain stock traders.

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