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Irrationally quick: the influence of time pressure on the Ostrich Effect

Master Thesis

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Abstract

The Ostrich effect is a specific (financial) instance of the information avoidance bias, where people tend to 'stick their heads in the sand' when confronted with information that might cause mental discomfort. To see whether the Ostrich effect is impacted by time pressure, this paper uses a simulation[1] that provides a new way into monitoring active information avoidance under a more everyday decision making environment. In the experiment, participants performed an arithmetic task while trading in a stock simulation that was running in the background. The difference in monitoring behavior of the stocks between market upswings and downturns was used as a proxy for the Ostrich effect. Time pressure was introduced by letting the treatment group make the arithmetic questions under a time constraint while the control group has no such constraints. The study found no statistically significant impact of time pressure on the Ostrich effect, nor did the effect significantly change with stock trading experience. However, the inducement of time pressure seemed to increase the activity of the participants in the treatment group compared with the control group, providing some evidence of acceleration as a mode of adapting to time pressure. For future research, it is recommended to increase the sample size and use a group of respondents who are more experienced in stock trading to help increase the internal and external validity.

[1] I would like to thank Justin the Rooij for his contribution of helping me with creating the simulations.

Introduction

Keeping cool, calm and collected. That is a great skill to have when making important decisions under pressure. But not everyone has this ability. Humans often tend to display signs of biases when under pressure. Take information avoidance for example. When presented with declining markets, people are shown to avoid looking at their portfolios (Karlsson, Loewenstein & Seppi 2009), which contains crucial information when making decisions. This phenomenon, first called the Ostrich Effect in a paper by Galai & Sade (2006), is a great example of irrational behavior under pressure.

This paper will try to research whether time pressure plays an important role in making decisions. In an attempt to find this out, the following research question will be answered:

“What are the effects of time pressure on the Ostrich Effect?”

Some studies already found that time pressure influences decision-making (Sutter, Kocher & Strauß, 2003, Kocher & Sutter, 2006, Guo, Trueblood & Diederich, 2017). One possible explanation of why this might happen can be found in Kahneman’s book Thinking, Fast and Slow (2011). Here, thinking is divided in two systems. System 1 is quick and automatic, while system 2 is more calculating and logical. Time pressure however, seems to influence people in using system 1, instead of the more ‘rational’ system 2. Studies have shown that under time pressure, people are more prone to biases (Guo, Trueblood & Diederich, 2017, Guo, Lu, Kuang & Wang, 2020).

The Ostrich Effect is a specific (financial) instance of the more general information avoidance bias. Golman, Hagman & Loewenstein (2017) define information avoidance as not obtaining knowledge when it is freely available. The Ostrich Effect, more specifically, concerns the avoidance of information in situations where obtaining information might cause the person that searches for the information discomfort. Guo, Lu, Kuang & Wang (2020) showed that higher time pressure in a social network service environment leads to a higher presence of information avoidance. Since the Ostrich Effect also concerns information avoidance behavior, we expect to find a more pronounced effect under more time pressure.

Because the literature shows evidence that time pressure has the ability to influence certain biases, as well as evidence that a higher time pressure can result in a higher degree of information avoidance, an increase in time pressure could increase the Ostrich Effect. Using the literature, the following hypothesis is formed:

H1: “An increase in time pressure leads to an increase the Ostrich Effect”

In a paper by List (2003), it was found that traders can learn to become more rational. Next to this Feng & Seasholes (2005) showed that more market trading experience can lead to a decrease in the disposition effect. It therefore follows that the amount of experience in market trading might decrease the chance that an investor is influenced by a behavioral bias. Based on these results, the following hypothesis is formed:

H2: “People with more experience in stock trading will exhibit less the Ostrich Effect”

Though many studies have looked into the occurrence and implications of the Ostrich Effect, the influence of time on the Ostrich Effect has never been studied before. Decreasing the Ostrich effect is a topic that has not received a lot of academic attention. Finding factors that might influence the Ostrich effect can give some insight into how the Ostrich effect behaves under certain circumstances. Because the Ostrich effect is an information avoidance bias, more, insights that might be gained could also be applied to information avoidance biases as a whole. This paper therefore contributes to the existing literature by broadening the knowledge on how the Ostrich effect behaves under certain circumstances.

The simulation experiment that is used in this paper also provides a new way into monitoring active information avoidance under a more everyday decision making environment. This way, the observed (information avoidance) behavior might be closer to real life decisions.

This research is also socially relevant. The Ostrich Effect can not only result in negative outcomes in financial settings (avoiding information costs money if you are not careful), but can also have serious social effects. Take the example from Karlsson, Loewenstein & Seppi (2009) for instance. Parents with children who have chronic problems might not want to seek a definitive explanation of their child’s chronic condition. This is because of the fact that knowing (or rather confirming) that their child actually has an illness, cause the parents psychological discomfort. Finding ways to decrease the presence of the Ostrich effect can therefore also be socially relevant.

Literature review

Information avoidance is a phenomenon that is not only studied in the field of economics. In the field of psychology, information avoidance was studied as far back as the 1960's (before Behavioral economics was even considered as a separate field). Mills (1965) showed that the desirability of a product was highly correlated with the interest in reading ads about said product. This finding was in line with the even older theory of cognitive dissonance developed by Festinger (1957). Cognitive dissonance is the mental conflict that occurs when an individual's beliefs do not line up with their actions. As this causes mental discomfort, it would be preferred to not experience cognitive dissonance in the first place. Therefore, you would rather avoid information that conflicts with your personal beliefs. Getting back to the example of Mills (1965), people were shown to be less interested in ads about products which they preferred less. This result provided some evidence that people might want to avoid information that could cause the mental discomfort of cognitive dissonance.

As previously stated, information avoidance has a multitude of behavioral implications. Whether it be in a financial setting, leading to biases such as the Ostrich effect, a health setting, like the example of from Karlsson, Loewenstein & Seppi (2009), or even an everyday setting, like reading the news. Lazarsfeld et al. (1968) showed that US voters during the 1940's election tended only to expose themselves to information about their preferred party. Donsbach (1991) found a similar (although rather limited) effect of messages that contradicted a person's political views and their exposure to these messages when studying exposure to political content in German newspapers. Again this is in line with avoiding information that could cause a person mental harm.

To get a better feel for what we exactly mean when talking about information avoidance in an economic sense we turn to the paper by Golman, Hagman & Loewenstein (2017). Information avoidance can be extremely broad. Gathering information could be costly, discouraging someone to search for it. Even more straightforward, a person could simply be unaware that information exists in the first place, avoiding it by definition. To narrow down the specific case of information avoidance that we are looking for, we turn towards Golman, Hagman & Loewenstein (2017), who use the notion of 'active information avoidance'. This type of information avoidance must satisfy two conditions. First, the agent must be aware that the information exists. Second, the information that the agent receives must be free to access or would avoid the information even if the access to that information was free. To make sure that the information avoidance in the survey conducted in this paper is 'active', information given to the participants is known and freely accessible.

Over time, the definition of the Ostrich effect has changed. Galai & Sade (2006) first introduced the concept in a paper where they researched the relationship between liquidity and the yields of financial assets. The paper found that people choose to invest in assets where risks are unreported more quickly than assets where the risk is reported, both assets having the same risk. Following this result, Galai & Sade define the Ostrich effect as "(…) avoiding apparently risky financial situations by pretending the do not exist".

Karlsson, Loewenstein & Seppi (2009) changed the definition slightly in their paper. In this paper a model is created that tries to link the decision to gather information to the net utility gain that this information yields. When applying their model to monitoring behavior of Scandinavian and American bank accounts, investors tend to look at their portfolios more often when the markets are rising compared to when they are flat or falling. Karlsson, Loewenstein & Seppi (2009) define the Ostrich effect as "(…) avoiding exposing oneself to information that one fears will cause psychological discomfort".

In this paper we use the definition of Karlsson, Loewenstein & Seppi (2009), however in a slightly altered way. People "stick their heads in the sand[2]" and avoid information when the fear that the information could cause them psychological discomfort, but, when the coast is clear (for example when markets are rising), get their heads out of the sand and start actively seeking for information again. Information can not only yield discomfort, but it can also yield pleasure. Sicherman et al. (2016) found that investors checked their portfolios multiple times when markets were rising, even though checking the account more than once did not yield any extra information. Importantly, this paper considers the Ostrich effect as the difference in information seeking when the information provides either utility or disutility.

Many papers show that time pressure has the ability to change human decision making (Sutter, Kocher & Strauß, 2003, Kocher & Sutter, 2006, Guo, Trueblood & Diederich, 2017). Sutter, Kocher & Strauß (2003) showed that rejection rates increased in an ultimatum game where there were tighter time constraints. In another experiment, Kocher & Sutter (2006) showed that in an experimental beauty contest game, participants reach an equilibrium quicker as well as receive a higher pay-off under low-time pressure compared with participants who were under high time pressure.

Next to this, time pressure might also affect the presence of biases. Guo, Trueblood & Diederich (2017) showed that framing effects increase with time pressure. On the other hand, Svenson & Benson (1993)

[2] Full disclosure, an ostrich does not actually stick its head in the sand as is believed. The misconception is believed to stem all the way back from ancient Rome, when ostriches were observed nesting and being hunted by predators. [Ostriches Do Not Really Stick Their Heads in the Sand | Office for Science and Society - McGill University]

found that time pressure reduced framing effects. These results might indicate that time pressure may decrease biases. The main difference between these two papers was the time constraints. In the experiment of Guo, Trueblood & Diederich (2017) the decision time was only one second whereas in the paper by Svenson & Benson it was 40 seconds. Following these papers, it is possible to remark that framing effects were able to change when time pressure was introduced. Therefore, the Ostrich Effect might also be subject to change under different time constraint. It is however, reasonable to assume that with less decision time, time pressure is higher, and a person is more likely to rely on the bias prone system 1. To try to incorporate the higher time pressure, decision time will be limited to increase a sense of time pressure and hopefully to increase the usage of system 1 by participants.

The workings of time pressure are very complex and can impact decision making in a multitude of ways, whether it be through emotional, psychological or even physiological response. Maule, Hockey & Bdzola (2000) showed that time pressured participants were more anxious and energetic than participants without time pressure when having to make choices between safe and risky actions is risk scenarios. Next to this, a paper Teuchmann, Totterdell & Parker (1999) showed that mood and emotional exhaustion fluctuated in parallel with situations where there was an increased presence of time pressure over a longer period of time. Overall, there is some evidence that time pressure can elicit emotional responses.

In the book *Decision making: cognitive models and explanations* Maul & Edland (1999) dissect the effects of time pressure on human decision making. In particular, they take a look at the underlying processes in judgement and decision making which are affected by time pressure. Maul & Edland state that: “research has identified three broad modes of adapting to time pressure”. First, time pressure can lead people to accelerate, increasing the speed at which an activity is done. Benson and Beach (1996) show evidence of this acceleration. Participants increased the speed with which screened for jobs to meet a hypothetical description under time pressure. However, it was also shown that the screening patterns of the time pressured participants were more inconsistent than those of non-pressured participants. Second, people use filtration to reduce the amount of information processed. The active information avoidance for information that can cause psychological discomfort is one example of this filtration. On the other hand, Edland (1993) found no evidence of filtration based on positive or negative information. The third phenomenon considers a more substantial change in decision making under time pressure, altering the way in which people make use of cost-benefit analysis. Here, time pressure can lead people to decrease the value they put on high-information loads, time-consuming compensatory strategies and increase the value of simpler and less time consuming non-compensatory strategies (Christensen-Szalanski, 1980).

The complex implications that time pressure has on how humans make decisions make it hard to pin point the exact combination of mechanisms that actually influence a decision. However, the experiment was designed in such a way to be able to find some of these mechanisms if they occurred.

Methodology

To research whether time pressure can affect the Ostrich Effect, a simulation was used. In this simulation participants switched between solving simple math problems and trading in a simulated stock market. This design was chosen to simulate a real life decision making environment. Since not everybody trades stocks, or trades stocks all the time, the math tasks was made for the stock simulation to feel as a background task (because trading stocks, for many people, is also considered as a "background" task). The amount of times participants switched between solving math problems and trading in the stock simulation will be used to construct the measure of the Ostrich effect. In particular, we look at the difference of the times people check or trade in the stock simulation between periods where the market went up and periods where the market went down.

Experimental design

The experiment was run through a Qualtrics survey was created in Qualtrics. Within Qualtrics, you have the ability to code with JavaScript, which was essential in order to create a simulation. This simulation was split into two parts; one foreground task where participants were asked to solve certain math problems and one background task where participants were able to trade stocks within a stock simulation. The simulation ran in such a way that participants were working on doing the mental arithmetic questions, while a stock simulation was running in the background.

Math Task

The mental arithmetic questions consisted of adding up three randomly generated numbers. These numbers were randomly chosen between 1 and 32 to keep the sum below 100. In order to give an answer to the question that was given, a participant had to fill in their answer and click a button to hand in their answer. Participants were informed whether they got the question correct or incorrect and a counter of the amount of correctly answered was always on display. For every correctly answered math question, the participant received €0.10. Average earnings for the math task were €2.10.

Stock Simulation Task

The stock simulation consisted of two stocks (Stock A and Stock B) with fluctuating prices over a period of time. Participants started with an endowment of $50 in Stock A. The prices of the stock changed over time and participants could decide to buy either stock A or Stock B. Importantly, there was no ability to sell the stocks, meaning the entire portfolio value was invested at all times in one of the two stocks. The participants were also always notified of how much their stock portfolio was worth in the stock simulation.

The stock simulation was equally divided into four periods. Two periods had increasing stock prices (both for stock A and stock B) and two periods have decreasing stock prices. Because participants were always invested in one of the stocks they experienced both periods where there was a market downturn (both A and B decline) and periods where markets were rising (both A and B increase). By measuring the amount of times participants switch between the math task and the stock simulation when prices are rising and subtracting the amount of times participants switch when prices are falling, the Ostrich Effect can be measured. The Ostrich Effect implies that participants 'stick their heads in the sand' when prices are falling and will stop looking at the stock simulation and gain pleasure from looking at the stock simulation when markets are up. Therefore, the amount switches should be higher in periods where prices are rising compared with periods where prices are falling.

The stock simulation consisted of 72 price points. Each price point updated every 3.33 seconds, making the total duration of the simulation 4 minutes.

For the stock simulation, participants received the full profit they earned during the survey, which was calculated by taking the value of the portfolio at the end of the simulation and subtracting the original endowment of €50. Average earnings for the stock simulation task were €7.74.

The opportunity cost of opening and trading in the stock simulation is reflected in the amount of money that a participant misses due to not making the math questions. However, because it is hypothesized that participants might attach value to seeing their stock value going up in the stock simulation, or vice versa, dislike monitoring their portfolio value when stocks are going down, the cost benefit analysis of the participant might change based on the state of the market. This could create a discrepancy between stock monitoring/trading when the markets are going up compared to when they are going down

Simulation Environment

The foreground math tasks were made on 'the main menu' (Appendix A, figure 1.1 & figure 1.2). This main menu also included a button that allowed participants to switch to the stock simulation and a timer for the time pressure treatment group. The (open stock simulation) button on the main menu opened a pop-up screen for the participants, where the stock simulation was presented (Appendix A, figure 1.3). Lastly, the main menu showed information about how the stocks in the stock simulation were performing every 30 seconds. The information was shown as a percentage change over these 30 seconds for both stock A and stock B. Percentage increases were displayed in green, while decreases were displayed in red. This way, even if participants were not actively paying attention to the stock simulation, participants knew how the stocks are performing. Importantly, this information was free and participants were made aware of the information, therefore meeting the requirements for active information avoidance as has been stated by Golman, Hagman & Loewenstein (2017).

Survey flow

Participants were first asked for consent before filling in the survey. Next, an information section was shown. This consisted of a few important bits of information which allowed the participant to know how the simulation would work. Participants were informed that the simulation would last for four minutes. They were shown what the buttons in the simulation did and participants were notified that they would have a chance to win money based on their performance in the stock simulation and the amount of correctly answered math question according to the specified incentive scheme. After this information section, people could try out the simulation for themselves in a practice round that lasted for 1 minute. This practice round was a shorter version of the real simulation (of course the two simulations used different price points). After participants completed the practice round they were presented with the real simulation. After the real simulation, some control questions were asked (including age, gender, occupation and whether someone ever traded in stocks before), as well as 6 questions that helped to measure a participant's financial literacy (these questions were taken from a financial literacy test created by Finra, questions gotten from: https://www.finra.org/financial_literacy_quiz). Participants were given the choice to enter their email to get a chance to win the money that they accumulated during the survey. At the end of the data collection, one person was randomly drawn to receive their money. In total the survey lasted for about 10 to 15 minutes.

Treatment

To see whether time pressure can influence the Ostrich Effect, a treatment group was created where participants were subjected to time pressure. This was done by adding a time constraint to the computational tasks. Participants in the time pressure treatment group had to give an answer to a math question within 7 seconds. When participants gave an answer or if 7 seconds go by, a new math question was generated. Importantly, if a participant did not fill in their math question within the 7 seconds, the math question was not considered to be correct or incorrect. The participant simply received a new question.

Both Byström & Järvelin (1999) and Olsen & Olsen (2013) used stopwatches to increase feelings of time pressure. Therefore, the treatment group received a timer which allowed participants to see how long had before having to answer the math question and added a sense of time pressure. The timer ran down in intervals of milliseconds, making the feeling of time running out even more prevalent. The control group had no timer when doing the math task.

Variables and data collection

In this experiment, the main dependent variable is a proxy for the Ostrich effect. As we discussed before, the difference between switching to the stock simulation in market upswings and downswings will be used. To be able to compare this measure between participants, the proxy controls for the amount of times the participants switched to the stock simulation during the entire experiment. The following formula presents how the *Ostrich* variable was calculated:

$$Ostrich\ effect = \frac{Stock_{Up,1} - Stock_{Down,1} + Stock_{Up,2} - Stock_{Down,2}}{Stock_{Up,1} + Stock_{Down,1} + Stock_{Up,2} + Stock_{Down,2}}$$

Where $Stock_{i,t}$ is the amount of times the stock simulation was opened in which market state $i \in \{Up, Down\}$ and time period $t \in \{1,2\}$. The value of this variable is between -1 and 1. Here, -1 corresponds to an opposite Ostrich effect, i.e. the participant only opens the stock simulation when the market is down. If the *Ostrich effect* variable is 0, the participant opens the stock simulation an equal amount of times in market upswings as in market downswings, meaning there is no Ostrich effect. Lastly, a participant displays the Ostrich effect to the fullest extent when they only open the stock simulation during market upswings, giving the *Ostrich effect* variable a value of 1. To conclude, following the theory behind the Ostrich effect, we expect the *Ostrich effect* variable to be positive.

There are two main independent variables that will be used in the analysis. The first is a simple binary variable that indicates whether a participant is in the control or the time pressure treatment group. *Treatment group* is 0 for the control group and 1 for the time pressure treatment group. The second variable measures the financial literacy of a participant. The variable contains the amount of correctly answered finance answers. As there were six questions the variable *Financial literacy* contains integers between 0 and 6.

Furthermore, a few continuous variables measured the amount of correctly answered math questions (*correct*), the amount of incorrectly answered math questions (*incorrect*), the total amount of math questions answered (*amount*) and the percentage of correctly answered math questions (*percentage* *correct*). Also variable the variable *open* measured the total amount of times that the stock simulation was opened.

We control for a few background characteristics like age, gender, occupation and whether a participant had ever traded stocks. The *Age* variable contains four categories, these being 18-25, 26-40, 41-64 and 65+. *Gender* contained the categories Male, Female, Third gender/non-binary, Prefer not to say. *Occupation* was categorized by Student, Employed, Unemployed or Other. The Finally, the binary variable *Stock trading* was set to 1 for participants who traded in stocks before and 0 for the rest.

Power calculation

We calculate the amount of participants that would ideally be used in the experiment with a power calculation. The number of participants will be calculated in two ways using the G*POWER calculation program. First we take a look at the power calculation under standard values used in experiments. Next we look at some results found in my Bachelor thesis to calculate the effect size and number of participants. For both calculations, we make use of the fairly standard significance level of α = 0.05 and power of q=0.8. In G*POWER the statistical test that will be used is the "linear multiple regression: Fixed model, single regression coefficient". As we will be using 10 independent variables in our regression, the number of predictors will be set to 10. Finally, we take the two-tail option to be able to perform two-sided tests.

Following Cohen (1988), an effect size $f^2 \geq 0.02$ is seen as small, while larger than 0.15 is medium and larger than 0.35 is large. Using the medium effect size, together with the previously stated parameters, we get a minimum total sample size of 55 participants.

When calculating the f^2 using data from my bachelor thesis we use the following formula.

$$f^2 = \frac{R_{AB}^2 - R_B^2}{1 - R_{AB}^2}$$

Here A is the variable of interest while B is the set of control variables. R_{AB}^2 is the r-squared of the 'full' model, including all variables, while R_B^2 is the r-squared of the model with just the control variables. We run two regressions on a proxy of the Ostrich effect, which is calculated in the same way as in this paper. Our main variable of interest is a treatment dummy which indicates whether a participant received a stress treatment. The set of control variables include age, gender and occupation and whether somebody traded in stocks before. The regression output is given in Appendix B, table 1. We get that $R_{AB}^2 = 0.129$ and $R_B^2 = 0.088$. With this we have $f^2 = 0.047$, which qualifies as a small effect size following the indexation of Cohen (1988). Putting this effect size in G*POWER together with the already specified parameters we get a minimum total sample size of 170 participants. Of course, because we randomize who gets into the control group and the time pressure treatment group, each group will contain half of the participants. Taking the medium effect size, each group should contain 28 participants while for the effect size based on past data we should have 85 participants per group.

Results

Table 1: Summary statistics

Variables	N	Mean (Sd)/ %
Treatment group		
Control group	24	48.00
Time pressure treatment	26	52.00
Gender		
Male	34	69.39
Female	13	26.53
Non-binary/third gender	1	2.04
Prefer not to say	1	2.04
Age category		
18-25	40	81.63
26-40	6	12.24
41-64	3	6.12
65+	0	0
Occupation		
Student	43	87.76
Employed	5	10.20
Unemployed	1	2.04
Other	0	0
Stock trading		
Yes	19	38.78
No	30	61.22
Financial literacy	50	4.50 (1.49)
Math Questions		
Correct	50	20.96 (13.51)
Incorrect	50	4.84 (4.15)

Notes: The variables Gender, Age category and Occupation are categorical variables. The number of participants within a category are given together with their percentage of the sample. The financial literacy score and the math question variables are continuous. The mean and standard deviations (in brackets) are given.

In table 1 we find the summary statistics. Data from 92 participants was collected. However, 42 of the participants did not finish the entire survey, therefore these observations were dropped. This brought the total number of observations to 50. We see that the randomization worked, as the participants were nearly equally split up into the control and treatment groups. Next, we can notice some overrepresentation within the categorical variables. The categories Male, 18-25, Student seem to be the majority of the observations captured in the Gender, Age category and Occupation variables respectively. We also note that there was no person who was older than 65 or who filled in other for the occupation question. Taking a look at the financial literacy proxies, we see that around 40 percent of the participant traded in stocks before. The average amount of correctly answered finance questions was 4.5 out of 6. Finally, we see that participants had on average about 5 times as many math questions correct as incorrect.

Balance test

Table 2: Balance test

Variables	Control group	Time pressure Treatment group	Difference
Gender			
Male	0.541	0.807	-0.266**
	(0.103)	(0.079)	(0.129)
Female	0.333	0.192	0.141
	(0.098)	(0.079)	(0.125)
Non-binary/third gender	0.042	0	0.042
	(0.042)	(0)	(0.040)
Prefer not to say	0.042	0	0.042
	(0.042)	(0)	(0.040)
Age category			
18-25	0.792	0.808	-0.016
	(0.085)	(0.079)	(0.116)
26-40	0.167	0.077	0.090
	(0.078)	(0.053)	(0.093)
41-64	0	0.115	-0.115*
	(0)	(0.064)	(0.067)
Occupation			
Student	0.833	0.885	-0.051
	(0.078)	(0.064)	(0.100)
Employed	0.125	0.077	0.048
	(0.069)	(0.053)	(0.086)
Unemployed	0	0.038	-0.038
	(0)	(0.038)	(0.040)
Stock trading	0.562	0.654	-0.089
	(0.106)	(0.095)	(0.142)

Financial literacy	4.33	4.65	-0.321
	(0.344)	(0.254)	(0.423)
Total	24	26	

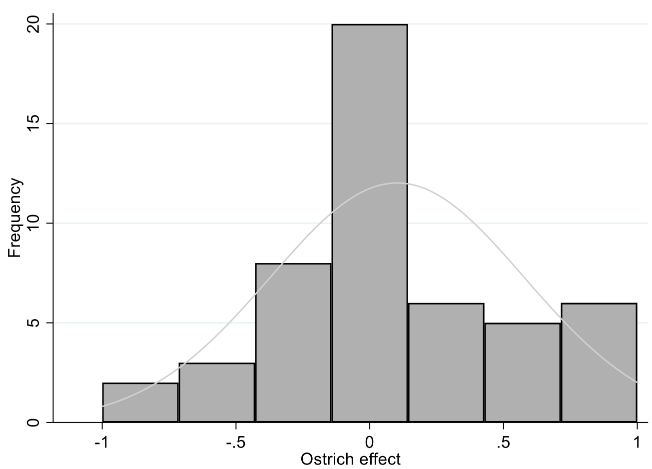
Notes: All variables are compared between control and treatment group. The difference between the two group are given. The significance stars indicate when the difference of a certain variable (or category within a categorical variable) is significant between the control and treatment group. All variables except for financial literacy are given as fractions, while financial literacy gives the mean. Standard errors are given within parentheses. *** p<0.01, ** p<0.05, * p<0.1

To see whether there were any significant differences within the variables between the control and treatment group, a balance test was conducted. T-tests were used to see if the differences between groups. In table 2 we see the results of the balance test, which was run over all categories in the three categorical variables, the Stocks dummy and the financial literacy variable. Two significant difference were found. The fraction of males was significantly lower in the control group at a significance level of α=0.05 and the fraction of 41-64 year olds was higher in the treatment group at a significance level of α=0.10.

Analysis

To see what kind tools to use in order to test the hypotheses, we first take a look at the dependent variable. We start by looking at how the Ostrich effect is distributed.

Figure 1: Histogram of the Ostrich effect



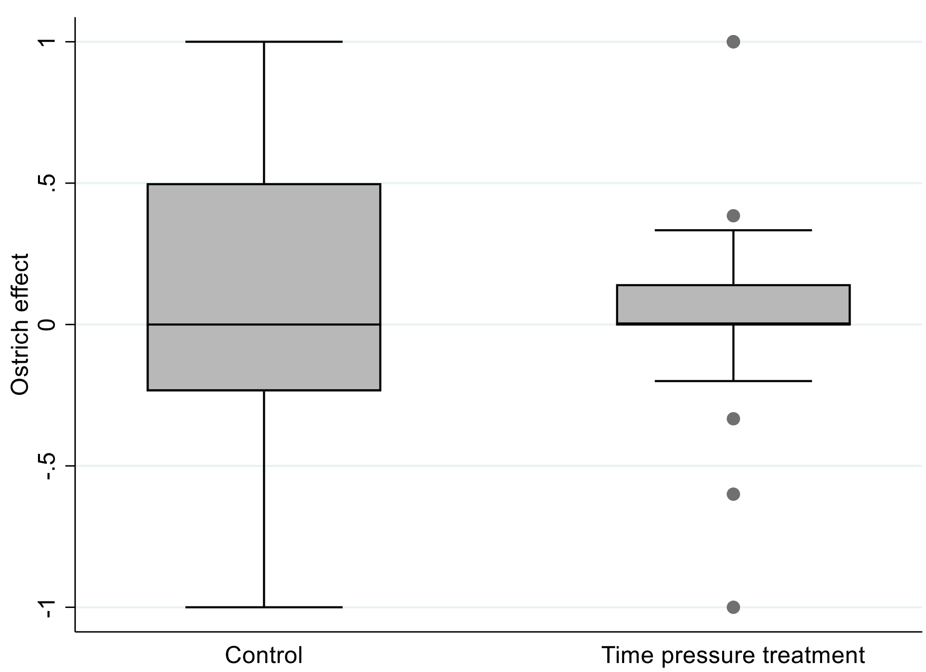
Notes: This figure depicts the histogram of the Ostrich effect variable. The x-axis gives the value of the Ostrich effect while the y-axis gives the density of the amount of observations given the value of the Ostrich effect. The line represents the normal distribution that fits the histogram the best.

In figure 1, we find the histogram of the Ostrich effect. We see that values around 0 have the highest frequency. As is the case for a normal distribution, it seems that the bulk of the observations is clustered around middle of the distribution. However, it seems that the distribution does not taper off to the extreme values in a perfectly symmetric way. We also see that values of 1 seem to occur more than values of 0.5 for example. To test whether the dependent variable actually stems from a normal distribution, three tests will be performed.

First the Shapiro-Wilk test for normal data was performed. At a significance level of α=0.05 (p=0.039) we reject the null hypothesis which states that the data is normally distributed. When taking a look at the Shapiro Francia test, however, we cannot reject the null hypothesis (even at significance level of α=0.10, p=0.111) that the data is not normally distributed. When testing the third and fourth moments of the normal distribution, we perform a skewness and kurtosis test for normality. This test also does not allow us to reject the null hypothesis (p=0.638), indicating that the skewness and kurtosis are not dissimilar from a normal distribution.

Because we will be analyzing results between the control and treatment group, it is also necessary to check whether the variance of the Ostrich effect is the same between the groups. First we take a look at the boxplot of the Ostrich effect between the two groups.

Figure 2: Box plot of the Ostrich effect per treatment group



Notes: this figure displays a boxplot for the Ostrich effect variable between the control and time pressure treatment group. The box runs from the first quartile until the third quantile. The whiskers of the boxplot represent the values that are the furthest from the mean but still within 1.5 standard deviations. Finally, the dots represent the outliers. Control group: mean= 0.118, standard deviation= 0.522, interquartile range= 0.736. Treatment group: mean= 0.088, standard deviation= 0.435, interquartile range= 0.142.

In figure 2 we see that the values of the Ostrich effect seem to be more compactly distributed in the treatment group than in the control group. This is also supported by the fact that the interquartile range is lower in the treatment group compared with the control group. We also that the treatment group has some outliers, while the observations of the control group seem to be bounded within the whiskers of the box. This observation is interesting since it implies that the amount of times that the stock simulation was opened seems to be more consistent over the periods of market upswing and downturn in the treatment group than in the control group. This is observation goes against the findings of Benson and Beach (1996), who showed that people's decisions become more inconsistent when under time pressure.

To test this, we use Levene's robust test for the equality of variances. The test states that the null hypothesis cannot be rejected (p=0.116), therefore the variances of the Ostrich effect in the control and treatment group seem to be equal.

Following the results of the Shapiro Francia, skewness and kurtosis and Levene's test, we will make use of parametric tests for our main analysis. To be thorough, however, non-parametric test will be used as robustness checks to account for the results of the Shapiro-Wilk test.

As discussed before, the Ostrich effect predicts that people tend to avoid information more when things are not going well. With the way in which the Ostrich effect variable was calculated, we expect to see positive values. A positive value for the Ostrich effect variable indicates that a participant opens the stock simulation more during times of market upswing, compared with times of market downturns. To test whether this is actually the case we use a one sided t-test. The result of the test shows that the Ostrich effect is only significantly bigger than 0 at a 10% significance level [$t(49)=1.531$, $p=0.067$].

Table 3: Regression results of the Ostrich effect

Variables	Model 1	Model 2	Model 3	Model 4	Model 5
Treatment group	-0.0298	-0.130			-0.849*
	(0.137)	(0.148)			(0.420)
Financial Literacy			0.0303	0.0226	-0.0601
			(0.0451)	(0.0466)	(0.0713)
Treatment*Financial literacy					0.157*
					(0.0905)
Stocks		0.0243		-0.00917	0.00677
		(0.135)		(0.133)	(0.132)
Age category					
26-40		-0.381		-0.374	-0.315
		(0.254)		(0.255)	(0.264)
41-64		-0.293		-0.454	-0.382
		(0.516)		(0.486)	(0.582)
Occupation					
Employed		0.689**		0.769***	0.719**
		(0.261)		(0.232)	(0.348)
Unemployed		0.189		0.269	0.219
		(0.474)		(0.459)	(0.535)
Gender					
Female		-0.147		-0.122	-0.213
		(0.184)		(0.204)	(0.219)
Non-binary/third gender		-0.400***		-0.318***	-0.377***
		(0.139)		(0.0853)	(0.131)
Prefer not to say		-1.922***		-1.909***	-2.066***
		(0.289)		(0.307)	(0.412)
Constant	0.118	0.233	-0.0336	0.0718	0.527
	(0.107)	(0.146)	(0.225)	(0.262)	(0.379)
Observations	50	49	50	49	49
R-squared	0.001	0.346	0.009	0.335	0.392

Notes: A total of 50 participants were used for this regression. Five models are presented, which all use the Ostrich effect variable as dependent variable. Model 1 just includes the treatment effect, while in model 2 some control variables are added. Model 3 includes the financial literacy score and in Model 4 the control variables are added. Model 5 is the full model which includes both main independent variables and an interaction effect. The categories within the categorical variables Age category, Occupation and Gender are given as dummy's. The base categories are age category 18-25, Student and Male for Age category, Occupation and Gender respectively. The stocks variable is 0 for participants who have traded in stocks before and 1 for participants who have not. Estimated coefficients are given with their respective robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1

To test the two hypotheses that were formulated, five regression models we used. The results can be found in table 3. For the first model, the time pressure treatment dummy is regressed against the Ostrich effect. No significant treatment effect was found. When adding control variables, the treatment effect is still not significant.

The third and fourth model take a look at whether the financial literacy of the participant could affect the Ostrich effect. In the third, only the financial literacy proxy is used. No significant effect was found. The fourth model includes some control variables, but again, the financial literacy variable was insignificant.

In the fifth model, all variables are included together with an interaction effect. Importantly, here we see that the treatment variable is significant at a 10% significance level. When a participant has a financial literacy score of 0, and is assigned to the time pressure treatment group, on average the Ostrich effect decreases by 0.849 ceteris paribus. However, since there was only one observation that has a financial literacy score of 0, this effect might not give an accurate representation of the real effect. The same model was run with a reversed measure of the financial literacy (0 now being the highest score and 6 the lowest). Here the base category where financial literacy is 0, is presented with a bigger fraction of the sample than in the first measure (14 participants had all questions correct). In this alternative model, we see that the treatment variable is insignificant again.

We note that in none of the five models the measure of the Ostrich effect increases with the time pressure treatment group. Because the measure of the Ostrich effect was a proxy for the Ostrich effect itself, we find some evidence that the first hypothesis “An increase in time pressure will increase the Ostrich Effect” could be disproven.

Getting back to the fifth model, the interaction effect is significant at a 10% significance level. When a participant is assigned to the treatment group and gets an extra financial literacy question correct, the Ostrich effect increases by 0.157 ceteris paribus. Funnily enough, this seems to point to the fact that the higher financial literacy might increase the Ostrich effect among participants in the treatment group. However, the financial literacy variable is still insignificant. The same results we obtained when using the reverse financial literacy measure. Next to this, we see that in every model, the stocks variable is insignificant. This implies that we do not find that having traded stocks before has any significant impact on the Ostrich effect. Combining the fact that neither financial knowledge nor stock trading experience yielded any significant impact on the Ostrich effect in all five models, the second hypothesis “People with more experience in stock trading will suffer less from the Ostrich Effect” is disproven.

A few of the control variables were significant. In model 2, 4 and 5 being employed meant a significant increase in the Ostrich effect of 0.689, 0.769 and 0.719 respectively compared to being a student ceteris paribus. The effects were significant at a 5% significance level. For gender, both the non-binary/third gender and prefer not to say category had a significantly lower Ostrich effect compared with males in model 2, 4 and 5. For these control variables, however, it is good to note that the base category represented the majority of the observations. Therefore, these results might not be accurate.

Manipulation checks

To test whether the time pressure treatment actually induced a feeling of time pressure among participants, we take a look at the amount correctly and incorrectly answered math questions and compare them between the control and treatment group.

Table 4: Time pressure manipulation check

Variables	Control group	Time pressure Treatment group	Difference
Correct	17.54	24.11	-6.57*
	(2.55)	(2.72)	(3.75)
Incorrect	1.83	7.62	-5.78***
	(0.35)	(0.74)	(0.84)
Amount	19.38	31.73	-12.36***
	(2.73)	(2.91)	(4.01)
Percentage correct	0.826	0.707	0.118*
	(0.054)	(0.037)	(0.065)
Total	24	26	

Notes: All variables are compared between control and treatment group. The difference between the two group are given. The significance stars indicate when the difference of a certain variable (or category within a categorical variable) is significant between the control and treatment group. All variables except for Percentage correct give means, while Percentage correct is given as a fraction. Standard errors are given within parentheses. *** p<0.01, ** p<0.05, * p<0.1

We start by taking a look at the amount of correctly answered math answers. In table 4 we see that the control group answered significantly less math questions correctly than the treatment group at a 10% significance level. When looking at the amount of incorrectly answered math questions, a two-sided t-test shows that the time pressure treatment group had significantly more questions incorrect than the control group at a 1% significance level. It is then evident that the amount of math questions answered in total was higher for the treatment group than for the control group (also significant a 1% significance level). Here the control group answered an average of 19.4 questions while the treatment group answered on average 31.7 questions. This might indicate that the treatment group was overall more focused on the math questions than during the simulation than the control group. Finally, we take a look at the percentage of correctly answered math questions to the total amount of math questions answered. We find that the treatment group had a significantly lower percentage of correctly answered math questions compared with the control group, at a 10% significance level. The higher share of incorrectly answered math questions might be an indication that the time pressure treatment worked.

We also take a look at whether the financial literacy questions were a good proxy for financial experience. To do this, we look at the connection between the amount of correctly answered financial literacy questions and whether a person ever traded in stocks. A t-test shows that the financial literacy scores are not significantly different from each other across participants who had and had not traded in stocks before [$t(47)=-0.48$, $p=0.631$]. This might be an indication that the financial literacy score might not be a great indicator of the actual stock trading experience of a participant.

Robustness checks

First we take a look at some non-parametric test results to see, in the case that the results from the Shapiro-Wilk test holds true, if the regression results are robust. We will use two Mann-Whitney U tests to see whether the Ostrich effect is different between the control and treatment group and whether it is different between people who have and have not traded in stocks before. Because the financial literacy score is seen as a categorical variable a Kruskall-Wallis test will be conducted.

Table 5: Mann-Whitney U test

Mann-Whitney U test	N	Rank Sum	Expected Rank Sum	Adjusted Variance	P-value
Treatment group					
Control group	24	614	612	2542.23	0.973
Time pressure treatment	26	661	663		
Stocks					
Yes	19	446	475	2270.67	0.550
No	30	779	750		

Notes: This table displays the results of two Mann-Whitney U tests. Both test use the ostrich effect as their dependent variable. The first test, tests the different rank sums over the treatment group variable, while the second test uses the variable which indicates whether a participant has traded in stocks before. The amount of observations, rank sum, expected rank sum, adjusted variance and p-value are given. *** p<0.01, ** p<0.05, * p<0.1

As we see in table 5, when running the Mann-Whitney U test on the treatment variable, no statistically significant differences were found. This indicates that there is not enough statistical evidence to conclude that the Ostrich effect is different between the control and treatment group. When running the test for the Stocks variable, no significant results were found either. Finally, the Kruskall-Wallis test yielded no significant results [$\chi^2(6)=3.34$, p=0.765]. There is not enough statistical evidence to state that the Ostrich effect was different between the different levels of financial literacy.

Next, some checks will be done to see whether the Ostrich effect might have been influenced by other factors. First, we test whether the participants opened the stock simulation more in the control or treatment group. A two-sided t-test was performed which yielded no statistically significant results [$t(48)=0.837$, p=0.407]. On average the control and treatment group opened the stock simulation about as often (5.9 times for the control group and 4.8 times for the treatment group). Next we check whether the amount of correct and incorrect math answers influenced the amount of times a participant opened the stock simulation. The results are shown in table 3.

Table 6: Regression results of the amount times the stock simulation was opened

Variables	Correct	Incorrect	Percentage correct
Correct	0.0102		
	(0.0876)		
Treatment * Correct	0.00380		
	(0.116)		
Incorrect		0.950**	
		(0.373)	
Treatment * Incorrect		-1.552***	
		(0.458)	
Percentage correct			3.618*
			(2.088)
Treatment * Percentage correct			4.286
			(5.599)
Treatment	-1.309	5.181*	-3.753
	(2.768)	(2.973)	(3.919)
Constant	5.779***	4.218***	2.971*
	(1.848)	(1.180)	(1.730)
Observations	50	50	50

R-squared	0.016	0.182	0.081

Notes: A total of 50 participants were used for these regressions. Three models are displayed which all use the amount of times the stock simulation was opened as its main dependent variable. Model 1 includes the effect of the correctly answered math questions on the dependent variable, while model 2 includes the incorrect answers and model 3 the percentage of correctly answered questions. Robust standard errors are given in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In table 6 we see that the amount of correctly answered math questions had no impact on the amount of times the stock simulation was opened. We also see in Model 2 that when a participant got a math question incorrect, they opened the stock simulation 0.950 times more ceteris paribus. This effect is significant at a 5% significance level. We also see that in the treatment group, with every incorrect answer, the amount of times the stock simulation was opened decreased by 1.552 ceteris paribus. This effect is significant at a 1% significance level. The last thing we can see from model 2 is that the treatment group opened the stock simulation 5.181 times more than the control group. This is significant at a 10% significance level. An interesting thing to note here is that in the control group, for every incorrectly answered question on average the participant opened the stock simulation more. This could be interpreted as a kind of 'escape' of not having to do the math questions and checking the stock simulation instead. Therefore, the participant could avoid answering the math question incorrectly. For the treatment group however, it seems that answering a question incorrectly made them focus more on the math question and not on opening the stock simulation.

Finally, in model 3 we see that a one percentage point increase in percentage of correctly answered questions leads to the participants to open the stock simulation 0.036 times more ceteris paribus. This effect is significant at a 10% significance level.

To see whether the amount of correctly and incorrectly answered math questions had any impact on the Ostrich effect, some regressions were run. Three models were used where the amount of correctly answered math questions, the amount of incorrectly answered math questions and the percentage of correctly answered math questions were regressed on the Ostrich effect. However, no statistically significant results were found.

Finally, some last checks were conducted to see whether the financial literacy of the participants made any difference in the amount of times the stock simulation was opened. First, a regression was run to see whether there was a significant difference in the amount of times the stock simulation was opened under different levels of the financial literacy variable. No statistically significant effect was found. Last, a two sided t-test was run to see whether the amount of times the stock simulation was opened differed between people who had and had not traded in stocks before. No statistically significant difference was found [t(47)=0.21, p=0.832].

Post-hoc power calculation

To see what power we achieved with the main analysis, we perform a post-hoc power calculation. The calculations are made with the same parameters that were used in the a-priori calculations. Here we use the significance level of α = 0.05, 10 independent variables and a total of 49 participants. We calculate the Cohen's f^2 using the fifth model of the main regression results as the full model and the control variable model. Regression outputs can be found in Appendix B, table 2. We find that $R_{AB}^2 = 0.392$ and $R_B^2 = 0.332$. With this we have $f^2 = 0.099$, which qualifies as a small effect size. This effect size is two times bigger than the effect size of the a-priori calculations. These parameters were used in G*POWER, to calculate the achieved power, which turned out to be $\beta = 0.70$, which is lower than the desired power of $\beta = 0.80$. This might be an indication that the sample was too small to achieve enough statistical power.

Conclusions

In this paper we took a look at whether time pressure could impact the Ostrich effect. The research question that was used to find out whether this was the case was: “What are the effects of time pressure on the Ostrich Effect?”. Finding out whether time pressure has any significant impact on the Ostrich effect could be helpful to get more insight into the workings of the Ostrich effect and information avoidance biases in general.

Using a simulation created in the survey program Qualtrics, 50 participants were asked to switch between making mental arithmetic questions and trading in a stock simulation. Randomly, half of the participants made the survey under time pressure. This was done by adding a time constraint on the mental arithmetic questions. The Ostrich effect was measured by taking the difference in this switching behavior across times when the stock market was up compared to times when the stock market was down.

Following the results of the survey, some weak statistical evidence showed that when participants received the time pressure treatment, the size of the Ostrich effect decreased. This goes against the first hypothesis, which stated that “An increase in time pressure will increase the Ostrich Effect”. Next to this, the finding also contradicts the findings of Guo, Lu, Kuang & Wang (2020).

The second hypothesis stated that “People with more experience in stock trading will suffer less from the Ostrich Effect”. However, the results showed no statistically significant effect of financial literacy or whether a participant had traded in stocks before on the Ostrich effect. Though this finding goes against the findings of List (2003) and Feng & Seasholes (2005), the second hypothesis is disproven within the context of this paper’s experiment.

Getting back to main research question, “What are the effects of time pressure on the Ostrich Effect?”, we can conclude that there is some weak evidence to show that exposing people to time pressure can help decrease the size of the Ostrich effect.

Discussion

With the way that the experiment was set up, there are a few threats to the internal and external validity of the results. Next to this, because the survey was created in Qualtrics, some practical issues came to light. In this section, we will discuss both.

First we note that the amount of observations was lower than the calculated amount of participants in the power calculation section based on a medium effect size and previous research. Therefore, the results gained from the regressions and statistical tests might differ if the amount of observations is increased. To see whether this is the case, the experiment could be performed again with a bigger sample.

Next, we discuss the treatment. Participants in the treatment group were exposed to a time pressure situation, where they had to compute some mental arithmetic questions with a timer. To make sure this time pressure was maximally felt under the participants, the timer ran down from seven seconds in interval of thousands of seconds. In the treatment check section, the amount of correctly and incorrectly answered math questions was compared between the control and treatment group. The percentage of correctly answered math questions was significantly higher for the control group than the treatment group. Therefore, the time pressure treatment group made relatively more mistakes than the control group. This might give some evidence that the time pressure treatment was effective in influencing the participants. This finding is consistent with the findings of Kellogg et al. (1999), where it was found that timing manipulation negatively affected arithmetic performance.

It was also shown that the treatment group made significantly more math questions than the control groups. This might suggest that the timer (and time pressure) made the participants in the treatment group focus more on the math questions. However, it was also shown that the amount of times the stock simulation was opened did not significantly differ between the control and treatment group. We also see that the amount of actions (making math questions and opening the stock simulation) overall is higher in the time pressure treatment group than in the control group. This might be explained though the acceleration mechanism described by Maul & Edland (1999). Participants in the time pressure treatment group might have responded to the time pressure treatment by accelerating their actions relative to the control group.

The amount of correctly and incorrectly answered math questions as well as the percentage of correctly answered questions did not significantly impact the Ostrich effect. The only significant effect that was found was focused on the amount of incorrect questions. Here it seemed that the more incorrect questions a participant had, the less a participant opened the stock simulation. It therefore might be that after answering a question incorrectly, participants gained some kind of tunnel-vision on making the math questions. However, because this did not significantly impact the Ostrich effect, it seems that this effect is not substantial.

Next, we showed that the financial literacy proxy might not have been the best proxy for indicating whether people had any experience in stock trading. The proxy was not significantly higher among participants who traded in stocks before compared with those who had never traded in stocks. This might imply that the six finance questions that were asked did not provide enough information to make out whether a participant traded in stocks before. These questions were chosen to give a quick, yet effective indication of someone's financial literacy. Because the survey was already on the long side (10 to 15 minutes), an extensive financial literacy quiz might have caused participants to stop the survey. However, some questions about whether the participant trades in stocks as a profession or the amount of years a participant traded in stock might have been good proxies as well. In the end, the results showed that both the proxy for financial literacy and the stocks dummy did not have any significant impact on the Ostrich effect.

When focusing on the external validity, we can immediately notice that a majority of the participants were male students, aged 18-25. Next to this, less than half of the participants in the sample had ever traded in stocks before. On top of that, having traded in stock before does not necessarily make you an experienced stock trader. Though the Ostrich effect is a bias that affects both experienced and inexperienced stock traders alike, the results found in this paper might not apply very well to the more experienced full time stock traders.

The simulation in general might also have been difficult for participants to understand. At the beginning of the survey, quite some information and was presented to participants along with a handful of instructions. Though people got a practice round to get acquainted with the simulation and figure out what all the buttons did, some participants might have gotten overwhelmed by the survey. Out of the 92 observations that were collected, 42 observations had to be dropped. The four-minute duration of the simulation was chosen to make sure that the stock simulation did not run too fast (72 price points, with a new price point every 3.33 second). However, this might have been a bit too long for participants to keep their full concentration, even with the incentives. Though it might lengthen the survey a bit, for a future research it might be useful to add some questions to see whether participants understood the instructions of the survey.

Finally, we get to some practical issues with coding the stock simulation. The simulation was coded in such a way that a pop-up screen was opened when people wanted to look at the stock simulation. However, there was no way to code the html (layout) of the stock simulation within the pop-up window from the original Qualtrics survey. To figure out a way around this, two surveys were created. A main survey, that contained the math question simulation and the rest of the control questions and such, and a stock simulation survey. Each time the pop-up window was opened, participants were directed to this second survey where they were able to trade. This presented a problem, since participants had to be linked between the two surveys, to make sure that it was the same participant in both surveys. To make this link, a random four-digit code was given to participants at the end of the stock simulation. Participants had to fill in this code in both surveys, which made linking participants between the two surveys possible. However, this added another degree of complexity to the survey. Next to this, the participants could not be made aware of how much money they made. If this were the case, participants might have been extra motivated to see their earnings after the practice round. In the end, data gathered in the stock simulation (how many times participants bought stock A, Stock B and how much profit a participant made in the stock simulation) was not usable in the main analysis of the data.

References

Benson III, L., & Beach, L. R. (1996). The effects of time constraints on the prechoice screening of decision options. Organizational Behavior and Human Decision Processes, 67(2), 222-228.

Byström, K., & Järvelin, K. (1995). Task complexity affects information seeking and use. Information processing & management, 31(2), 191-213.

Christensen-Szalanski, J. J. (1980). A further examination of the selection of problem-solving strategies: The effects of deadlines and analytic aptitudes. Organizational Behavior and Human Performance, 25(1), 107-122.

Cohen J. E. (1988). *Statistical Power Analysis for the Behavioral Sciences*. Academic press.

Donsbach, W. (1991). Exposure to political content in newspapers: The impact of cognitive dissonance on readers' selectivity. European Journal of Communication, 6(2), 155-186.

Edland, A. (1993). The effects of time pressure on choices and judgments of candidates to a university program. Time pressure and stress in human judgment and decision making, 145-156.

Feng, L., & Seasholes, M. S. (2005). Do investor sophistication and trading experience eliminate behavioral biases in financial markets? Review of Finance, 9(3), 305–351.

Festinger, L. (1962). *A theory of cognitive dissonance* (Vol. 2). Stanford university press.

Galai, D., & Sade, O. (2006). The "Ostrich Effect" and the Relationship between the Liquidity and the Yields of Financial Assets. The Journal of Business, 79(5), 2741-2759.

Golman, R., Hagmann, D., & Loewenstein, G. (2017). Information avoidance. Journal of Economic Literature, 55(1), 96-135.

Guo, L., Trueblood, J. S., & Diederich, A. (2017). Thinking fast increases framing effects in risky decision making. Psychological science, 28(4), 530-543.

Guo, Y., Lu, Z., Kuang, H., & Wang, C. (2020). Information avoidance behavior on social network sites: Information irrelevance, overload, and the moderating role of time pressure. International Journal of Information Management, 52, 102067.

Kahneman, D. (2011). *Thinking, fast and slow*. Macmillan.

Karlsson, N., Loewenstein, G. & Seppi, D. (2009) The ostrich effect: Selective attention to information. J Risk Uncertain, 38, 95–115.

Kellogg, J. S., Hopko, D. R., & Ashcraft, M. H. (1999). The effects of time pressure on arithmetic performance. Journal of Anxiety disorders, 13(6), 591-600.

Kocher, M. G., & Sutter, M. (2006). Time is money—Time pressure, incentives, and the quality of decision-making. Journal of Economic Behavior & Organization, 61(3), 375-392.

Lazarsfeld, P. F., Berelson, B., & Gaudet, H. (1968). The people's choice. In *The people's choice*. Columbia University Press.

List, J. A. (2003). Does market experience eliminate market anomalies? Quarterly Journal of Economics, 118, 41–71.

Maule, A. J., Hockey, G. R. J., & Bdzola, L. (2000). Effects of time-pressure on decision-making under uncertainty: changes in affective state and information processing strategy. Acta psychologica, 104(3), 283-301.

Maule, A. J., & Edland, A. C. (2002). The effects of time pressure on human judgement and decision making. In *Decision making* (pp. 203-218). Routledge.

Mills, J. (1965). Avoidance of dissonant information. Journal of Personality and Social Psychology, 2(4), 589–593.

Olson, J., Olson, L. (2013). Virtual team effectiveness and sequence of conditions. International Journal of Management and Information Systems, 17(1), 1-12.

Sicherman, N., Loewenstein, G., Seppi, D. J., & Utkus, S. P. (2016). Financial attention. The Review of Financial Studies, 29(4), 863-897.

Sutter, M., Kocher, M., Strauß, S. (2003). Bargaining under time pressure in an experimental ultimatum game. Economics Letters, 81 (3), 341-347.

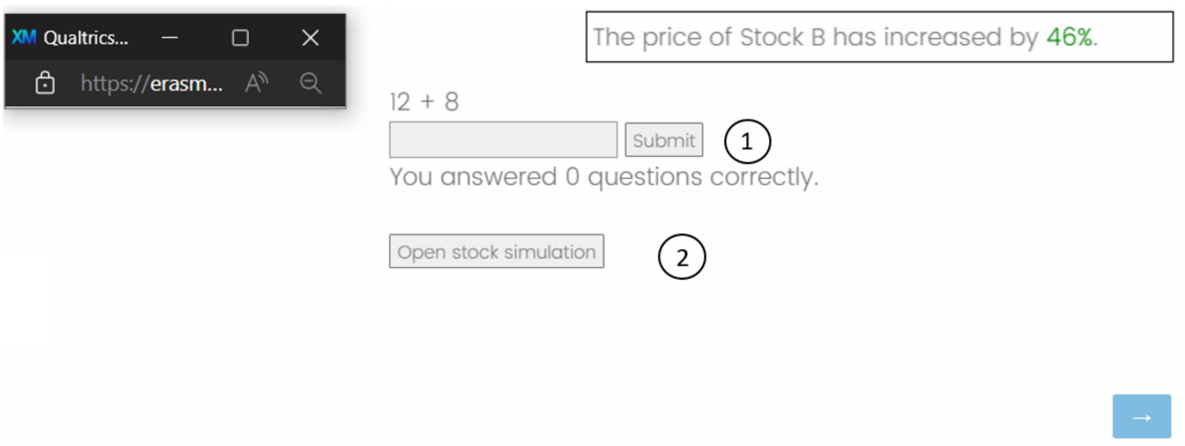
Svenson, O., & Benson, L. (1993). Framing and time pressure in decision making. In *Time pressure and stress in human judgment and decision making*. Springer.

Szollos, A. (2009). Toward a psychology of chronic time pressure: Conceptual and methodological review. Time & Society, 18(2-3), 332-350.

Teuchmann, K., Totterdell, P., & Parker, S. K. (1999). Rushed, unhappy, and drained: an experience sampling study of relations between time pressure, perceived control, mood, and emotional exhaustion in a group of accountants. Journal of occupational health psychology, 4(1), 37.

Appendix A

Figure 1.1: Image of the 'main menu' for the control group

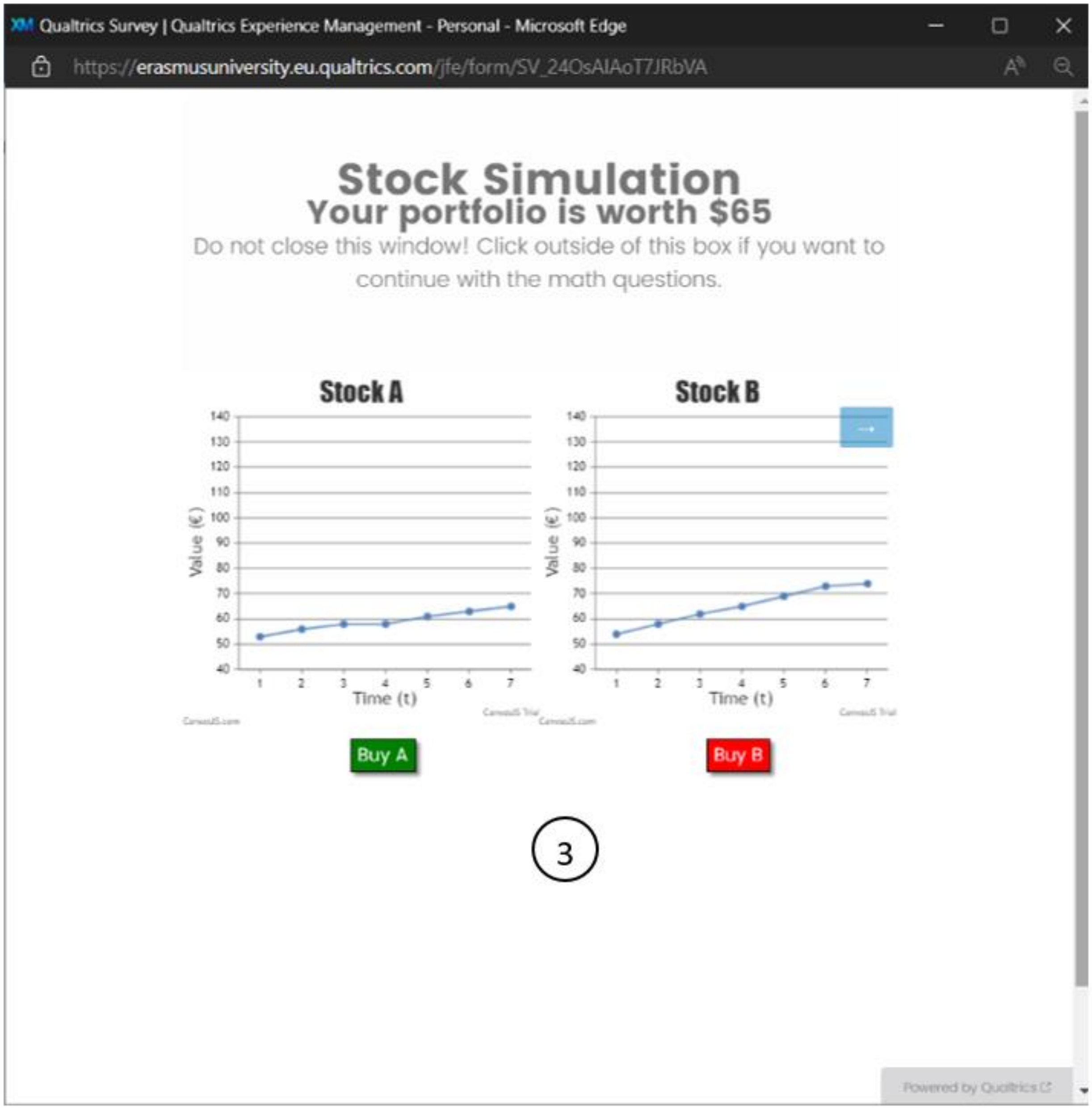


Notes: Here the submit button (1) submits the participant's answer to the math question and the open stock simulation button (2) opens the stock simulation running in the background. Note that there is no timer here, as the control group did not receive any time pressure treatment.

Figure 1.2: Image of the 'main menu' for the control group

Notes: Here the submit button (1) submits the participant's answer to the math question and the open stock simulation button (2) opens the stock simulation running in the background. Note the timer is included for the treatment group.

Figure 1.3: Image of the stock simulation



Notes: Here the participant had the option to buy either stock A or B with the two buy buttons (3).

Appendix B

Table 1: Regression output Bachelor thesis

Variables	Control model	Full model
Stress treatment		0.182*
		(0.0975)
Age		
18-25	-0.320***	-0.184**
	(0.104)	(0.0824)
26-39	-0.414	-0.261
	(0.323)	(0.296)
41-64	-0.343*	-0.216
	(0.200)	(0.184)
Occupation		
Employed	0.0262	0.0413
	(0.141)	(0.153)
Unemployed	0.0774	0.123
	(0.0951)	(0.106)
Other	0.0882	0.0189
	(0.140)	(0.125)
Female	-0.0362	0.0210
	(0.179)	(0.192)
Stocks	-0.173*	-0.174*
	(0.0988)	(0.0971)
Constant	0.406***	0.225**
	(0.0988)	(0.0915)
Observations	49	49
R-squared	0.082	0.129

Notes: Two regression are given in this table. For both models the dependent variable is the proxy for the Ostrich effect, which contains values between -1 and 1[3]. The first model includes only control variables. The second model is the full model which includes both the variable of interest, the dummy variable stress treatment, and the control variables. Age is a categorical variable with as base category the age category 0-17. The occupation variable is a categorical variable with as base category students. Both Female and Stocks are binary variables. Robust standard errors are given in parentheses. *** p<0.01, ** p<0.05, * p<0.1

[3] The Ostrich effect variable was altered in this regression compared with the Ostrich effect that was used in my bachelor thesis. In my bachelor thesis, the Ostrich effect contained the absolute amount 'information lookups' while in this regression, the Ostrich effect variable is calculated in the same way as is being done in this master thesis (controlling for the amount of 'information lookups').

Table 2: Post-hoc power calculation regression outputs

Variables	Control Model	Full model
Treatment group		-0.849*
		(0.420)
Financial Literacy		-0.0601
		(0.0713)
Treatment*Financial literacy		0.157*
		(0.0905)
Stocks	-0.00194	0.00677
	(0.132)	(0.132)
Age category		
26-40	-0.363	-0.315
	(0.251)	(0.264)
41-64	-0.438	-0.382
	(0.491)	(0.582)
Occupation		
Employed	0.764***	0.719**
	(0.249)	(0.348)
Unemployed	0.264	0.219
	(0.464)	(0.535)
Gender		
Female	-0.136	-0.213
	(0.193)	(0.219)
Non-binary/third gender	-0.314***	-0.377***
	(0.0849)	(0.131)
Prefer not to say	-1.938***	-2.066***
	(0.297)	(0.412)
Constant	0.174	0.527
	(0.117)	(0.379)
Observations	49	49
R-squared	0.332	0.392

Notes: A total of 49 participants were used for this regression. Two models are presented, which both use the Ostrich effect variable as dependent variable. Model 1 is the full model which includes both main independent variables and an interaction effect. Model only includes the control variables. The categories within the categorical variables Age category, Occupation and Gender are given as dummy's. The base categories are age category 18-25, Student and Male for Age category, Occupation and Gender respectively. The stocks variable is 0 for participants who have traded in stocks before and 1 for participants who have not. Estimated coefficients are given with their respective robust standard errors in brackets. *** p<0.01, ** p<0.05, * p<0.1