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Abstract

We study whether the COVID-19 pandemic has impacted risk preferences, comparing the results of experiments conducted before and during the outbreak. In each experiment, we elicit risk preferences from two sample groups: professional traders and undergraduate students. We find that, on average, risk preferences have remained constant for both pools of participants. Our results suggest that the increases in risk premia observed during the pandemic are not due to changes in risk appetite; rather, they are solely due to a change in beliefs by market participants. The findings of our paper support the traditional view that, at least on average, risk preferences are not affected by economic or social circumstances.

Key words: risk aversion, financial markets professional, COVID-19, experimental economics

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1 Introduction

In March 2020, following the outburst of the Coronavirus pandemic (COVID-19), we have observed a sharp fall in asset prices and a sharp increase in risk premia, across maturities and asset classes. Of course, such market turmoil is partially due to a change in market participants' assessment of future economic outcomes. One may wonder, however, whether it is also due to a change in agents' risk tolerance. We answer this question by measuring risk preferences in an experiment with a sample of professional traders and one of students.

Assessing whether risk preferences are a stable individual characteristic or change over time, and whether they are affected by the business cycle or major economic or social events is of fundamental importance to understand economic outcomes. Risk preferences affect agents' saving, consumption, and investment decisions. An increase in risk aversion after a negative shock, for instance, could lead people to lower consumption and investment in risky assets, thus depressing asset prices, exacerbating an economic downturn, and making recovery slower.[1]

Despite the importance of understanding the stability of risk preference, research in this field is very limited. The difficulties in collecting empirical evidence are easy to understand. To mention but one confounding factor, agents' beliefs change during the cycle, and these changes are hard if not impossible to observe in actual markets.

COVID-19 is arguably the biggest shock to developed economies since World War II. Because of the pandemic, human activities have been disrupted to an extreme degree for a time of peace. At the time we are conducting this study, April 2020, entire countries are under lockdown. The loss of human lives is still under scrutiny by the scientific community, but excess deaths in the first part of the year are estimated to be large, with health systems unable to cope with the peak of the pandemic. The IMF forecast for real GDP growth for the year 2020 is -6.5% in the UK and is -5.9% in the US. Unemployment has reached record numbers, in the USA (more than 23 million unemployed workers), in the UK (more than 800,000 firms applying for wage compensations for

[1] While the standard approach in economics is to take preferences as fixed, time-varying risk aversion has also been used. For instance, in a well-known contribution, Campbell and Cochrane (1999) use a consumption-based asset pricing model with habit formation (which implies countercyclical risk-aversion) to explain a variety of asset pricing phenomena, like the pro-cyclicality of stock price changes or the countercyclicality of stock market volatility and solve famous puzzles (e.g., the equity premium puzzle).

more than 6 million workers) as in most other developed economics. Asset prices have plummeted, with the FTSE index depreciating by 20% between 24th February and 24th April and the NYSE losing 19% of its value during the same period. The price of WTI crude oil has gone into negative territory, -40$ a barrel on the 20th April, which had never happened before. For this reason, assessing whether the pandemic has changed risk preferences is not only important to understand economic outcomes during the pandemic itself, but also to investigate—more in general and in a natural setting—whether preferences are a stable feature of individual behavior or whether they are affected by history and economic circumstances.

We study the stability of risk preferences by comparing the results of an experiment on decision making under risk conducted with the same pool of participants before COVID-19 (in 2019) and at the time of COVID-19 (April 2020). In the experiment, we use not only the standard experimental economics subjects (undergraduate students), but also professional traders and portfolio managers; observing the choices of people who professionally trade and invest in markets is very important in reassuring us of the external validity of our study.[2] Before the pandemic, in 2019, we ran a laboratory experiment in which we elicited risk preferences using the methodology of Crosetto and Filippin (2013); we also asked participants to fill a series of questionnaires assessing their personality traits. In April 2020, when the pandemic was at its peak in London, we invited the same participants to repeat these tasks and asked additional questions to gauge the extent to which COVID-19 affected them.

We find that risk aversion has not changed during the pandemic. Before the pandemic, traders were less risk averse than students, and this has remained the case during the pandemic. We do observe some heterogeneity in the response of risk aversion to the pandemic across participants and we relate it to the pandemic experience and to the individual traits.

COVID-19 has both the features of a socially and humanly disruptive event and of a negative economic shock. Previous papers have studied the effects of both these phenomena on risk preferences.[3] Callen et al. (2014) show that exposure to violence and fear priming (recollection

[2] According to the taxonomy of Harrison and List (2004), our study is an artefactual field experiment. For a review of differences between students and financial professionals in economic experiments, see Frechette (2015).

[3] Twenty-five percent of variation in risk preferences can be explained by genetic variation (Cesarini et al., 2010).

of the violence) affect risky decisions and, in particular, increase a preference for certainty; the interpretation of their results has however been challenged by Vieider (2018). Cameron and Shah (2015) find that individuals who recently suffered a flood or earthquake in Indonesia exhibit higher aversion towards risk. Cassar et al. (2017) find an increase in risk aversion and changes in other preferences after a tsunami in rural Thailand. Cavatorta and Groom (2020) document changes in risk and time preferences as a result of counter-violence initiatives in the West Bank. All these studies are conducted in developing countries, and focus on extreme events of a violent nature. Although COVID-19 has been very disruptive by the standard of developed economies, it nevertheless does not compare to the ravaging of wars; this could explain the difference between these results and ours.[4]

Two other papers close to ours are Cohn et al. (2015) and Guiso et al. (2018). They both study how risk preferences change in a downturn. Cohn et al. (2015) use a laboratory experiment in which financial professionals are primed with a boom or a bust scenario in an artificial market. They find that those primed with a bust exhibit higher risk aversion. Note that the participants used in this study are financial professionals in general, whereas our professional sample is only made of people who directly trade or invest in the market (traders and portfolio managers). Guiso et al. (2018) use portfolio data and surveys to understand how clients of an Italian bank reacted to the 2008 crisis. They find an increase in risk aversion after 2008. Through a laboratory experiment, they support the view that these changes are mainly due to emotions. In the laboratory, some participants are asked to watch a 5-minute horror movie in order to prime fearful emotions; interestingly, these participants show higher risk aversion than those who did not watch the movie. Connecting the results of these two papers to ours suggests that agents may react differently in terms of risk preferences to priming in the laboratory compared to real life distressing events.

The rest of the paper is organized as follows. Section 2 explains the experiment. Section 3 describes the participant pool. Section 4 presents the results. Section 5 concludes. An Appendix presents additional results and the experimental instructions.

[4] A related question is tackled by Carvalho et al. (2016). Using a sample of low income households, they study whether changes in the availability of financial resources before and after payday are related to changes in decision-making. They find no evidence that risk preferences are different before and after payday.

2 The Experiment

We ran the study in February and March 2019 and then again in April 2020 (from the 9th to 21st). In 2019, we ran the experiment in the Experimental Laboratory for Finance and Economics (ELFE) in the Centre for Finance at the Department of Economics at UCL; in 2020, we ran the experiment online.

In 2019, participants came into the experimental laboratory and took part in a two-phase experiment (run with z-Tree — Fischbacher, 2007). In the first phase, they participated in market experiments; in the second phase, they executed a risk preference test and solved individual-level tasks aimed to measure their cognitive and non-cognitive abilities.[5]

In 2020, we invited the same participants to an online experiment (run with o-Tree — Chen et al., 2016; Holzmeister and Pfurtscheller, 2016). In April 2020, there were already more than 100,000 cases of COVID-19 and more than 15,000 deaths due to COVID in the UK. London, like the rest of the UK, was in a lockdown, with people allowed to leave their home only for specific reasons and for a short period. Universities were closed, teaching was exclusively remote. For most jobs, working from home had become the norm. In this second experiment, we measured participants' risk preferences and non-cognitive traits in the same manner as before. Furthermore, we asked participants to complete a questionnaire about the impact of COVID-19 on their lives.

We refer to the data gathered in 2019 as the "pre-COVID" Treatment and the data gathered in 2020 as the "COVID" Treatment.

In both treatments, we measure risk preferences by using the "Bomb Risk Elicitation Task" (BRET, Crosetto and Filippin, 2013). In the BRET, participants are shown a screen with 100 boxes and are asked to "open a number of boxes" (between 1 and 99). Each box contains 20 pence; therefore, earnings increase linearly with the number of boxes chosen. Among the boxes, however, there is one that, if chosen, makes the participant lose all their earnings (in the original version by

[5]For cognitive measures, we use the Raven IQ test (Raven, 1941 and 1990) and the 7-item Cognitive Reflection Test (Frederick, 2005; Toplak et al., 2014). For non-cognitive abilities, we gather data on each of the Big-5 personality traits (Openness, Conscientiousness, Extroversion, Agreeableness, and Neuroticism) using the 10-item Big 5 inventory (Rammstedt and John, 2007) as well as data related to their level of "Grit" (Duckworth and Quinn, 2009), "Locus of Control" (Cobb-Clark and Schurer, 2013), and "Self-Monitoring" (Snyder and Gangestad, 1986). We also measure the ratio between their 2nd and 4th right hand's digits in order to infer their exposure to prenatal hormones (2D:4D). We illustrate these tests in the Appendix.

Crosetto and Filippin (2013) this box was described as a box containing a bomb; we used a more neutral description of an "empty box"). The decision about the number of boxes to collect is a decision under risk. A risk-neutral participant collects 50 boxes. A risk-averse participant collects less than 50 boxes and a risk-loving one more than 50. The more boxes a participant collects the higher their degree of risk-seeking preference. For example, a participant with constant relative risk aversion (CRRA) preferences would choose 45 boxes with a risk aversion coefficient of 0.18; 40 boxes with a coefficient of 0.33; 30 boxes with a coefficient of 0.57; 20 boxes with a coefficient of 0.75.[6]

In the COVID Treatment, we also asked participants to answer a questionnaire about their experience of the pandemic, specifically: i) whether the participants or members of their household had been infected; ii) whether any relative or close friend had been infected; iii) the severity with which their daily lives had been affected; iv) the impact on their current financial situation; v) their expectations about the impact on their financial situation in one year; vi) how worried they were about the pandemic. Questions iii) to vi) are measured on a Likert scale.

3 Experimental Participants

We use two participant pools: i) traders and portfolio managers working in the city of London (UK); ii) UCL undergraduate students from all disciplines.

In 2019, we recruited 56 professional traders and 79 undergraduate students. Out of the original participants, we use data from 48 traders and 60 students who participated again in 2020.[7]

The participant pool of professional traders consists of 27 traders, 4 proprietary traders, 2 sales-traders, 9 portfolio managers, and 6 belonging to other categories (e.g., trading strategist or sales with management of virtual portfolios). Participants work in a variety of financial markets, such as equity, equity derivatives, FX, fixed income, and commodities. Twenty-seven participants are employed by an investment bank, 11 by an investment fund, and the others by other types of institutions (or preferred not to report their employer). Traders' age ranges between 24 and

[6]See Appendix for a comprehensive table.

[7]In total, 49 traders and 61 students participated in 2020. However, for one trader and one student the recording of risk preferences was incorrect.

50, with a mean of 34 years and a standard deviation of 6.5 years. Their average job tenure is 9.43 years, with a range between 1.5 and 21 years (standard deviation: 5.74 years). Twenty-nine participants have a Master degree, 4 an MBA, 14 a Bachelor degree. Twenty-nine participants studied economics or finance, 8 mathematics or physics, 8 engineering or computer science, and the remaining have a degree in other disciplines or did not declare it. Eighty-six percent of traders are men.

The participant pool of students comprises undergraduate students from all disciplines. The gender composition is similar to that of traders, with 80% of students being male. Students are younger than traders, with a mean of 21 years and a standard deviation of 1.7.

In both treatments, all participants were incentivized with 20 pence per box. In the Pre-COVID Treatment, traders earned an average of GBP 3.70 while students earned an average of GBP 4.90. In the COVID Treatment, traders earned an average of GBP 4.10 while students earned an average of GBP 4.90.[8]

4 Results

4.1 COVID-19 and Risk Preferences

Table 1 reports mean, median, and standard deviation of the BRET choice in the Pre-COVID and COVID treatments for the entire sample as well as separately for traders and students. As can be seen, BRET choices remain constant over time. Among all participants, the median BRET choice is 50 in both the Pre-COVID and the COVID treatments, and the mean BRET choice is 46.35 in the Pre-COVID Treatment and 48 in the COVID Treatment. Among traders, the median BRET choice is 50 in both treatments, while the mean increases by 3.13 boxes. Students also show very little change across treatments: their median BRET choice increases by 2.5 boxes, while the mean increases by 0.37 boxes.[9]

[8] As mentioned above, in the Pre-COVID Treatment, participants took part in other market experiments. Traders earned an average of approximately GBP 250 (US$304) and students earned an average of approximately GBP 25 ($30.45). In the COVID Treatment, all participants earned GBP 25 for participating in the online experiment in addition to their BRET earnings.

[9] Our student participants record similar average measures of BRET to Crosetto and Filippin (2013) findings of 46.5 boxes in the "Baseline" Treatment and 40 boxes in the "High Stakes" Treatment. For a participant with

Using a one-sample t-test on the difference in risk aversion measurements across periods, $\Delta BRET = (BRET_{COVID} - BRET_{pre-COVID})$, we find no treatment effect as we fail to reject the null hypothesis that $\Delta BRET = 0$ (the p-value is 0.32 for the entire sample, 0.17 for traders, and 0.85 for students).[10]

Table 1: Elicited Risk Preferences across Treatments

	Pre-Covid Treatment			COVID Treatment			$H_0 : \Delta BRET = 0$
	Mean	SD	Med	Mean	SD	Med	p-value
All ($N = 108$)	46.35	14.32	50.00	48.00	15.26	50.00	0.32
Traders ($N = 48$)	50.25	12.40	50.00	53.38	14.97	50.00	0.17
Students ($N = 60$)	43.23	15.07	43.50	43.70	14.19	46.00	0.85

Note: $\Delta BRET$ is the individual-level difference between the BRET choice in COVID and in Pre-COVID. The last column of the table reports the p-value of t-test that $\Delta BRET$ is zero. *: $p - value < 0.1$, **: $p - value < 0.05$, ***: $p - value < 0.01$.

Table 1 also shows that the variance of the BRET choices do not change noticeably across treatments. Among all participants, the standard deviation of BRET choices increases from 14.32 to 15.26. Among traders it increases slightly more, from 12.40 to 14.97, while decreasing somewhat among students from 15.07 to 14.19. We do not reject the equality of variances across periods either in the entire sample (p-value=0.70) or separately by participant pools (p-value=0.23 for traders; p-value=0.89 for students).[11]

Finally, Table 1 indicates a difference in BRET choices across the two participant pools. In the Pre-COVID Treatment, the mean BRET choice is 7.02 boxes higher for traders than for students; in the COVID Treatment this difference is 9.68. Using a t-test for the equality of means, and allowing

CRRA preferences, a choice of 43 boxes (our students' median choice) is equivalent to a coefficient of risk aversion equal to 0.25. This is in line with results presented by Holt and Laury (2002), who, using their elicitation mechanism, find that the coefficient for the median participant is between 0.15 and 0.41; similarly, Choi et al. (2007), using their elicitation method, estimate a median coefficient of 0.48. For a comparison of different risk elicitation methods, see Crosetto and Filippin (2016).

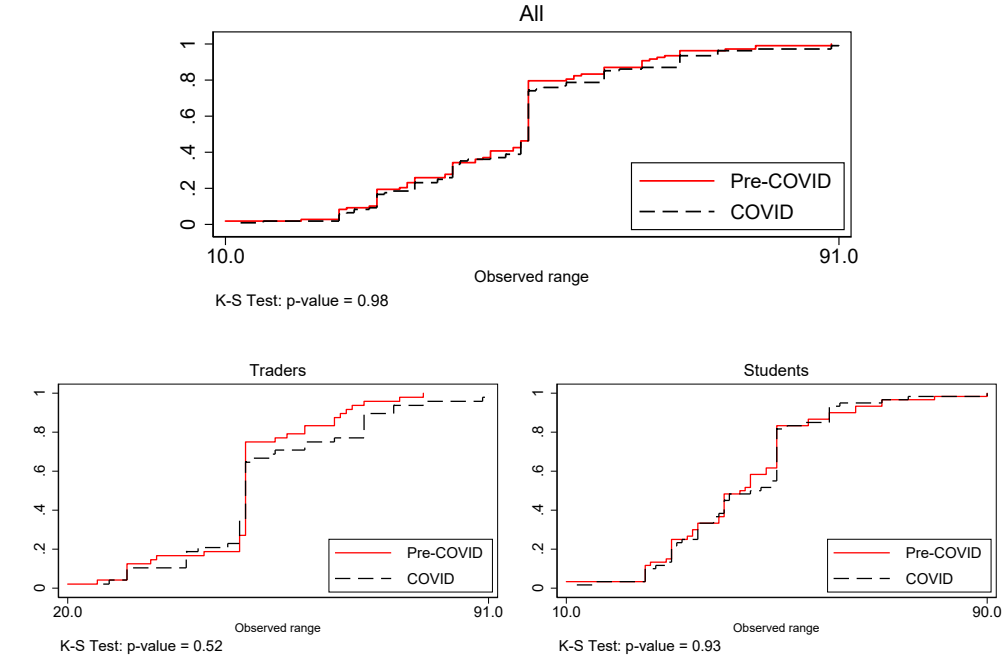
[10] We reach the same conclusions when using a Wilcoxon signed-rank test for the null that the central tendencies of the paired distributions are the same. Specifically, the p-values are 0.33 for the entire sample, 0.33 for traders, and 0.71 for students.

[11] We rely on the statistic proposed by Brown and Forsythe (1974), using the median as an estimator of the central tendency of the distribution. This statistic is robust under non-normality and more robust than a statistic using the mean as central tendency when distributions are skewed.

for unequal variances between groups, both differences are significant at a 1% level (p-values are 0.01 in the Pre-COVID Treatment, and 0.00 in the COVID Treatment).[12]

Figure 1 compares the distributions of BRET choices across the two treatments. The distributions of BRET choices in the two periods are not different for all study participants (Kolmogorov-Smirnov test for equality of distributions between treatments: p-value=0.98) as well as for the two separate participant pools (Kolmogorov-Smirnov test: p-value=0.52 for traders and 0.93 for students). Among traders, the likelihood of observing very large values of BRET choices is relatively higher in the COVID Treatment than in the Pre-COVID Treatment. This explains the slight increase in mean BRET choice, while the median BRET choice remains the same.

Figure 1: Distribution of Risk Preferences across Treatments



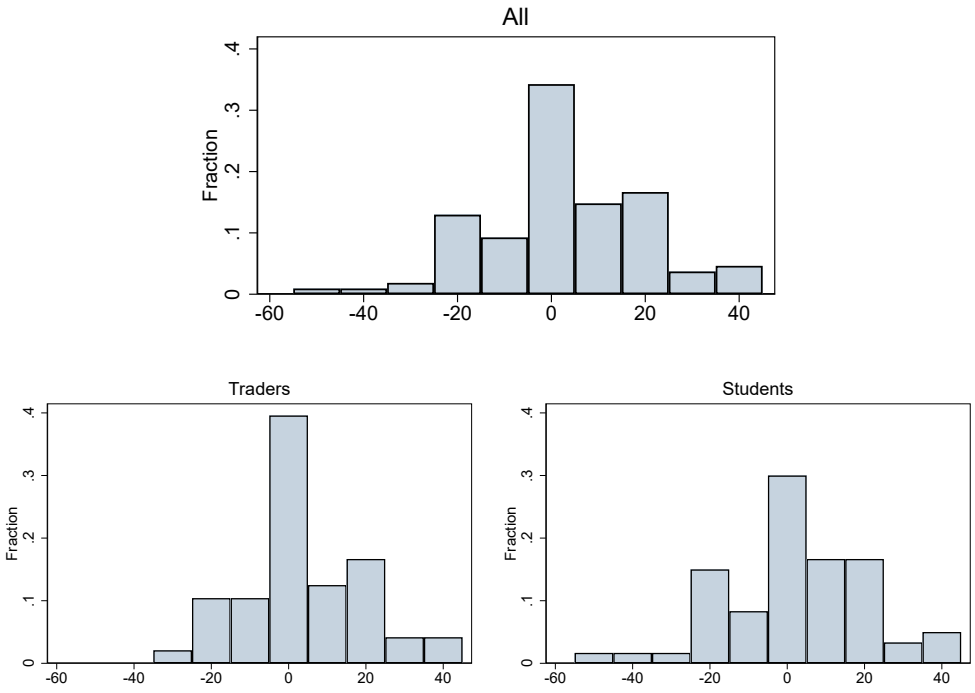
K-S Test is the Kolmogorov-Smirnov test for equality of distribution

Figure 2 presents the histogram of $\Delta BRET$. The similarity of BRET choices between the Pre-COVID and the COVID treatments is apparent. About 27% of traders did not change their BRET choices at all; 8% changed them by a maximum of 2 (in either direction), 13% by a maximum of

[12]We obtain the same results when using a Wilcoxon test, with p-values equal to 0.00 in both treatments.

5, and 31% by a maximum 10. Among students, 15% showed no change; 5% changed them by a maximum of 2 (in either direction), 22% by a maximum of 5, and 35% by a maximum 10. The correlation between BRET choices in the Pre-COVID and the COVID Treatment is 0.32 (significant at 1%) in the whole sample, 0.38 (significant at 1%) among traders, and 0.20 (significant at 10%) among students.

Figure 2: Histogram of Changes in Risk Preferences across Treatments



Given the previous results, one may ask whether we would have detected a shift in risk aversion given our sample size. With the one-sample t-test described above, assuming a 5% percent significant level, we would have detected a BRET change of 4.5 boxes (that is, 4.5 percent of the total number of boxes) or larger with a power of at least 80%. Thus, we are confident that we would have been likely to detect a meaningful shift in risk aversion, had it occurred.

As discussed in the literature review, the few existing empirical studies on the topic have indicated that adverse events increase risk aversion; this is also how economic theory has proceeded in modeling investors behavior, when departing from the standard assumption of time unvarying

risk preferences. Importantly, our data show that participants in the COVID Treatment collect an average of two additional boxes, thereby indicating a slight *decrease* in risk aversion. While this change is not statistically significant, it certainly does not support the prior that risk aversion has *increased* amid the COVID-19 pandemic. To address this more thoroughly, we test whether, given our data, the population average risk aversion measure has increased, by posing the null hypotheses $H_0 : \Delta BRET = x \in \{-1, ..., -5\}$. The p-values in the first column of Table 2 show that, in the entire sample, we are able to reject these nulls at conventional significance levels. In other words, if the true population shift were indeed an average decrease in BRET (increase in risk aversion) even by only one box, then the probability of our sample data would be relatively low (5.5% for 1 box, 1.5% for two boxes, 0.3% for 3 boxes). This exercise suggests that it is quite unlikely that we fail to reject the null of no change in risk aversion due to sample variability. When restricting attention to traders, we find that if the true population shift were an average decrease in BRET by only one box the probability of our sample data is only 3.5%; it is lower than 1% for an average decrease in BRET of 3 or more boxes in the trader population. Among students, who increased their BRET choices by just 0.5 boxes between the Pre-COVID and COVID treatments, the likelihood of observing our sample data is lower than 5% if there had been an average decrease in BRET of more than 3 boxes in the population. As an example, if student participants had CRRA preferences, a decrease of 3 boxes, from the mean value of 44 to 41, would be equivalent to an increase in the coefficient of risk aversion from 0.21 to 0.31.

Table 2: Probability of Rejecting $H_0 : \Delta BRET = x$ against $H_a : \Delta BRET > x$ (p-values)

	All	Traders	Students
$x = -1$	0.056	0.035	0.271
$x = -2$	0.015	0.013	0.153
$x = -3$	0.003	0.004	0.076
$x = -4$	0.000	0.001	0.033
$x = -5$	0.000	0.000	0.013

4.2 Impact of the COVID-19 Pandemic

As we discussed in Section 3, in the COVID Treatment, participants filled out a questionnaire about their experience with the COVID-19 pandemic.

Figure 3 reports the results of whether the participants had been infected by Coronavirus or whether this had happened to their relatives or close friends. Among all participants, 4.5% report that they have been diagnosed with the Coronavirus or think that they were. About one-quarter of the participants have had relatives or close friends diagnosed with the Coronavirus.[13]

Figure 3: Impact of the COVID-19 Pandemic (I)

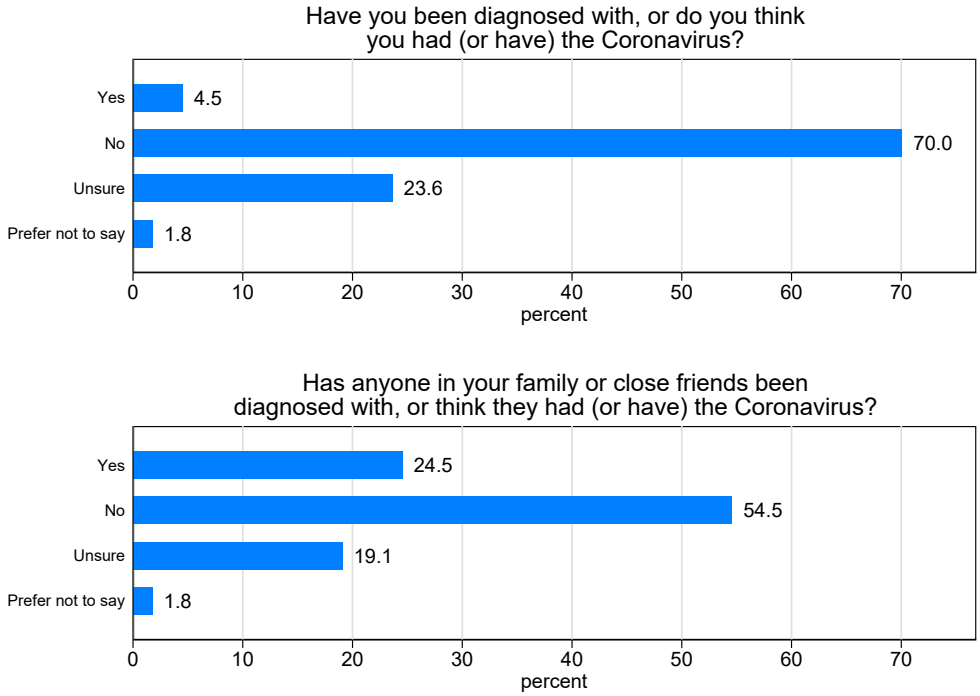
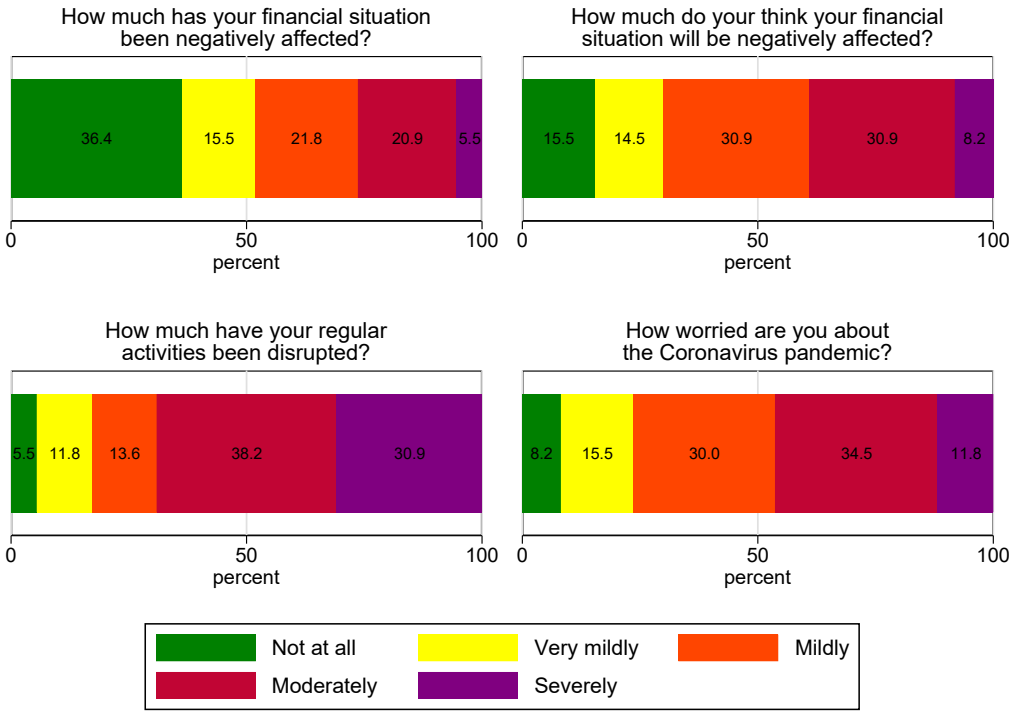


Figure 4 shows statistics about the reported impact of the pandemic on different aspects of participants' lives. One-quarter of the participants state that their current financial situation has

[13]The sample fraction of 4.5% reporting having been diagnosed results from 6% among traders and 3% among students, a non-statistically significant difference (p-value=0.46). The sample fraction of 25% reporting diagnosis of relatives or close friends results from 40% among traders and 13% among students, a statistically significant difference (p-value=0.00). Differences of proportions by participant pool are tested using a t-test with unequal variances across groups.

Figure 4: Impact of the COVID-19 Pandemic (II)



been either moderately or severely affected, while 36% state that it has not been impacted at all. About 40% think that their future financial situation will be negatively affected, while a minority of 15.5% believe that their finances will not be impacted at all in the future.[14]

There is large consensus in terms of how much regular work and school activities have been disrupted. For the vast majority, approximately 70% of participants, regular activities have been either moderately or severely disrupted. Only 5.5% of participants state that they have not been disrupted at all (a claim that should be put in the context of a lockdown that affected everyone). About 46% are very worried about the pandemic and 8% are not worried at all.[15]

[14]The sample fraction of 26% reporting moderate or severe impact on current financial situation results from 22% among traders and 29% among students, a non-statistically significant difference (p-value=0.40). The sample fraction of 39% reporting moderate or severe impact on future financial situation results from 43% among traders and 36% among students, a non-statistically significant difference (p-value=0.47).

[15]The sample fraction of 69% reporting moderate or severe activity disruption results from 65% among traders and 72% among students, a non-statistically significant difference (p-value=0.45). The sample fraction of 46% reporting being moderately or severely worried about the pandemic results from 39% among traders and 52% among students, a non-statistically significant difference (p-value=0.15).

4.3 Changes in Risk Preference: Heterogeneity in Response to COVID

Although risk aversion does not change on average, either in the whole sample or by participant pool, a fair fraction of participants changed their BRET choice between the Pre-COVID and the COVID treatments (see Figure 2). We study whether such changes are related to the individual's experience or perception of the pandemic. To do so, we divide the participants in three groups, depending on whether their BRET choices have decreased ($\Delta BRET < -4$), remained unchanged ($-4 \leq \Delta BRET \leq 4$), or increased ($\Delta BRET > 4$) between treatments.[16] We then create the categorical variable $\Delta BRET_{cat}$, taking values 1, 2, and 3 if BRET choices have decreased, remain unchanged, or increased, respectively. This categorization results in balanced proportions in the sample: 30% of study participants have decreased their BRET choices, 30% have left them unchanged, and 40% have increased them.

We estimate a Multinomial Logit model for $\Delta BRET_{cat}$ using as explanatory variables basic demographics, such as gender, age, a participant pool indicator (traders versus students), stated impact of the pandemic, as well as measures of cognitive and non-cognitive traits as elicited in the Pre-COVID Treatment. The variables capturing the impact of the pandemic include binary variables taking value 1 if individuals report either moderate or severe impact of the pandemic on current and future finances, activity disruption, and level of worry; and indicators for whether the participants or their relatives or close friends have been diagnosed with the Coronavirus. The variables measuring non-cognitive traits are scores for the Big-5 personality traits (Openness, Conscientiousness, Extroversion, Agreeableness, and Neuroticism), Grit, Locus of Control, Self-Monitoring, and the 2D:4D digit ratio. Cognitive traits are scores on the Raven IQ test and the cognitive reflection test (CRT). To ease the interpretation of the results, all individual traits are expressed as z-scores (with mean equal to 0 and standard deviation equal to one).[17]

We report the results of this exercise in Table 3, which shows average marginal effects with

[16] We choose a threshold of 4 as it corresponds approximately to the minimum detectable change in the BRET choice given our sample size (see Section 4.1 for more details). We experimented with different thresholds to classify a decrease/increase in risk preferences, ranging from 0 to ±5 and found that our results are robust to these different specifications.

[17] It should be noted that the sample size is reduced to 103 participants (from the original 108) due to missing values for some of the explanatory variables included in the model. All the tests reported in Section 4.1 give identical results when performed on this regression sample.

heteroskedasticity-robust Delta Method standard errors in parentheses.

In terms of heterogeneity driven by the pandemic's impact, two effects are particularly relevant. First, being moderately or severely worried about the pandemic increases the likelihood of keeping the BRET choice unchanged by about 20 percentage points (significant at the 5% level). This result is somehow at odds with Cohn et al. (2015) and Guiso et al. (2018), who report an increase in risk aversion by participants who have been primed to a bust scenario or to fear.

Table 3: Changes in Risk Preferences across Treatments: Heterogeneity by Pandemic's Impact and Individual Traits

	Decrease	No Change	Increase
High Impact on Current Finances	0.003	-0.101	0.098
	(0.103)	(0.104)	(0.118)
High Impact on Future Finances	-0.006	-0.010	0.016
	(0.082)	(0.078)	(0.099)
High Activity Disruption	0.136	-0.019	-0.117
	(0.088)	(0.084)	(0.088)
Worried about Pandemic	-0.047	0.188**	-0.140
	(0.089)	(0.092)	(0.096)
Diagnosed Own - Yes	0.064	0.240	-0.304***
	(0.223)	(0.263)	(0.107)
Diagnosed Others - Yes	0.113	0.169	-0.282***
	(0.120)	(0.106)	(0.083)
Openness	0.025	0.016	-0.042
	(0.052)	(0.050)	(0.042)
Conscientiousness	-0.062	-0.004	0.066
	(0.061)	(0.052)	(0.060)
Extraversion	0.086*	-0.038	-0.048
	(0.046)	(0.047)	(0.053)
Agreeableness	-0.102**	0.021	0.081*
	(0.048)	(0.053)	(0.049)
Neuroticism	-0.078*	0.066*	0.011
	(0.046)	(0.038)	(0.044)
Grit	-0.029	-0.028	0.057
	(0.067)	(0.073)	(0.068)
Locus of Control	-0.097	0.096	0.001
	(0.063)	(0.074)	(0.054)
Self-Monitoring	-0.078	0.118**	-0.040
	(0.049)	(0.051)	(0.052)
Digit Ratio	0.027	0.051	-0.078*
	(0.049)	(0.038)	(0.044)
IQ	0.013	-0.055	0.043
	(0.047)	(0.036)	(0.045)
CRT	-0.023	0.101*	-0.078
	(0.059)	(0.054)	(0.050)
Male	0.001	0.116	-0.117
	(0.120)	(0.130)	(0.121)
Age	-0.002	0.004	-0.002
	(0.010)	(0.011)	(0.008)
Trader	-0.017	0.037	-0.020
	(0.149)	(0.163)	(0.152)

Note: N=103. Multinomial Logit average marginal effects are reported with robust Delta Method standard errors in parentheses. *: $p - value < 0.1$, **: $p - value < 0.05$, ***: $p - value < 0.01$.

Second, participants who state that they have been diagnosed with COVID and participants who state that a relative or close friend has been diagnosed with COVID are 30 and 28 percentage points less likely to increase their BRET choices, respectively (both coefficients significant at 1% level).

Other factors do not seem to have a significant effect on risk preference changes. For example, there is no evidence of an impact of the pandemic on BRET choices because of negative consequences on current and expected future financial situation.

As far as non-cognitive traits are concerned, a one standard deviation increase in the level of Self-Monitoring is associated with a 12 percentage-point higher likelihood of keeping BRET choice unchanged. In addition, participants with a higher degree of Agreeableness are less likely to decrease their BRET choice. We find no effect associated with cognitive traits or with other demographic controls such as gender, age, and whether the participant is a trader or a student.

To understand differences between traders and students, we re-estimate the Multinomial Logit model including an interaction between the variables measuring the pandemic's impact and an indicator for whether the participant is a professional trader.[18] In Table 4, we report average marginal effects for each of the variables measuring the pandemic's impact separately for traders and students. The results reveal three interesting variations across participant pools. First, among students, being moderately or severely worried about the pandemic decreases the likelihood of increasing BRET choices whereas, for traders, it increases the likelihood of keeping BRET choices the same. Second, although overall being diagnosed with COVID makes individuals less willing to take risk, there is a different pattern between participant pools. Traders who report having been diagnosed are 58 percentage points more likely to maintain the same BRET choice and 48 percentage points less likely to increase their BRET choice. Diagnosed students are 36 percentage points less likely to keep their BRET choice the same and 35 percentage points more likely to decrease their BRET choice. Third, both pools are less likely to increase their risk aversion when a family member or close friend has been diagnosed with COVID; however, whereas traders with

[18]We also estimate a more parsimonious model that does not control for individual traits. The results of this exercise are substantially similar to those presented in the text and provided in the Appendix (Table A.1).

this answer are significantly more likely to keep the same BRET choices, students are more likely to reduce their BRET choices and less likely to increase them.

Taken together, the results in Tables 3 and 4 indicate that, while on average individuals have not changed their risk attitude in the midst of the COVID pandemic, there exists some heterogeneity driven by the perceived or experienced impact of the pandemic. Moreover, there are differences in the moderating role of the pandemic's impact across participant pools.

Table 4: Changes in Risk Preferences across Treatments: Heterogeneity by Pandemic's Impact for Traders and Students

	Traders			Students		
	Decrease	No Change	Increase	Decrease	No Change	Increase
Current	0.114	-0.026	-0.088	-0.057	-0.189	0.246
Finances	(0.144)	(0.175)	(0.190)	(0.126)	(0.126)	(0.153)
Future	-0.113	0.022	0.091	0.061	-0.068	0.007
Finances	(0.124)	(0.104)	(0.166)	(0.106)	(0.085)	(0.114)
Activity	0.241*	-0.147	-0.094	0.068	0.048	-0.117
Disruption	(0.131)	(0.097)	(0.150)	(0.106)	(0.103)	(0.109)
Worried about	-0.242	0.284**	-0.042	0.086	0.121	-0.208**
Pandemic	(0.160)	(0.122)	(0.172)	(0.106)	(0.113)	(0.105)
Diagnosed	-0.106	0.582***	-0.476***	0.346*	-0.365***	0.019
Own - Yes	(0.137)	(0.101)	(0.129)	(0.209)	(0.112)	(0.206)
Diagnosed	-0.055	0.331***	-0.276**	0.336**	-0.058	-0.278**
Others - Yes	(0.107)	(0.077)	(0.126)	(0.168)	(0.123)	(0.119)

Note: N=103. Same Multinomial Logit regression as in Table 3, adding interactions between variables measuring the pandemic's impact and the participant pool indicator. Average marginal effects of the variables measuring the pandemic's impact for traders and students are reported with robust Delta Method standard errors in parentheses. *: $p-value < 0.1$, **: $p-value < 0.05$, ***: $p-value < 0.01$.

5 Conclusion

At the time of this research (April 2020), many countries around the world are under lockdown because of the COVID-19. The economic decisions that consumers and investors are taking during the lockdown and those that they will take when the lockdown is over and economic activity fully resumes crucially depend, among other things, on their willingness to take risk. Can we expect

people to be less or more risk averse than before COVID-19? Our experimental study indicates that the shock to social and economic life due to the pandemic has not significantly affected risk preferences. This is true for both a sample of professional traders and one of students. The stability of risk preferences after arguably the biggest shock to developed economies after World War II suggests that preference for risk are a stable characteristics of individual behavior.

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6 Appendices (Online)

6.1 Additional Results

Table A.1: Changes in Risk Preferences across Treatments: Regression without Individual Traits

	All		
Panel A	Decrease	No Change	Increase
Current	0.039	-0.162	0.122
Finances	(0.107)	(0.101)	(0.118)
Future	-0.101	0.068	0.033
Finances	(0.090)	(0.088)	(0.100)
Activity	0.152*	0.000	-0.152
Disruption	(0.090)	(0.090)	(0.103)
Worried about	-0.086	0.222**	-0.136
Pandemic	(0.092)	(0.089)	(0.106)
Diagnosed	0.135	-0.002	-0.133
Own - Yes	(0.194)	(0.167)	(0.189)
Diagnosed	0.118	0.145	-0.262***
Others - Yes	(0.114)	(0.104)	(0.096)
Male	-0.058	0.240*	-0.182
	(0.125)	(0.127)	(0.126)
Age	0.002	0.005	-0.007
	(0.011)	(0.009)	(0.009)
Trader	-0.128	0.053	0.075
	(0.173)	(0.148)	(0.149)

	Traders			Students		
Panel B	Decrease	No Change	Increase	Decrease	No Change	Increase
Current	0.026	-0.022	-0.004	0.053	-0.255**	0.202
Finances	(0.124)	(0.155)	(0.168)	(0.155)	(0.129)	(0.154)
Future	-0.174*	0.043	0.131	-0.035	0.058	-0.023
Finances	(0.101)	(0.103)	(0.134)	(0.138)	(0.129)	(0.129)
Activity	0.212*	-0.044	-0.168	0.074	0.024	-0.098
Disruption	(0.111)	(0.117)	(0.141)	(0.140)	(0.132)	(0.135)
Worried about	-0.330**	0.350**	-0.019	0.067	0.129	-0.196
Pandemic	(0.161)	(0.145)	(0.180)	(0.148)	(0.136)	(0.137)
Diagnosed	0.071	0.385**	-0.456***	0.222	-0.301***	0.079
Own - Yes	(0.211)	(0.195)	(0.106)	(0.248)	(0.101)	(0.237)
Diagnosed	-0.015	0.210*	-0.195	0.327*	-0.004	-0.323***
Others - Yes	(0.136)	(0.118)	(0.144)	(0.190)	(0.179)	(0.124)

Note: N=104. In Panel A, Multinomial Logit average marginal effects are reported with robust Delta Method standard errors in parentheses. In Panel B, the same Multinomial Logit regression as in Panel A is estimated, adding interactions between variables measuring the pandemic's impact and the participant pool indicator. Average marginal effects of the variables measuring the pandemic's impact for traders and students are reported with robust Delta Method standard errors in parentheses. *: $p-value < 0.1$, **: $p-value < 0.05$, ***: $p-value < 0.01$.

6.2 Cognitive Ability - Raven's matrices (IQ)

For IQ, we selected a subset of the most difficult Raven's (1941) progressive matrices. Specifically, we selected the most difficult 18 matrices available in Raven's Advanced Progressive Matrices (Raven, 1990). We did this to avoid a ceiling effect on the scores (which we achieved, as the highest score recorded was 15). A participant's IQ score in our study is the number of correct answers within the 10-minute duration of the test.

6.3 Cognitive Ability - Cognitive Reflection Test (CRT)

The Cognitive Reflection Test (Frederick, 2005; Toplak et al., 2014) measures a participant's tendency to override an impulsive response that is incorrect in order to engage in further reflection that leads to the correct response. The test consists of 7 questions and a participant's CRT score is the number of correct answers within the 5 minute duration of the test.

6.4 2D:4D

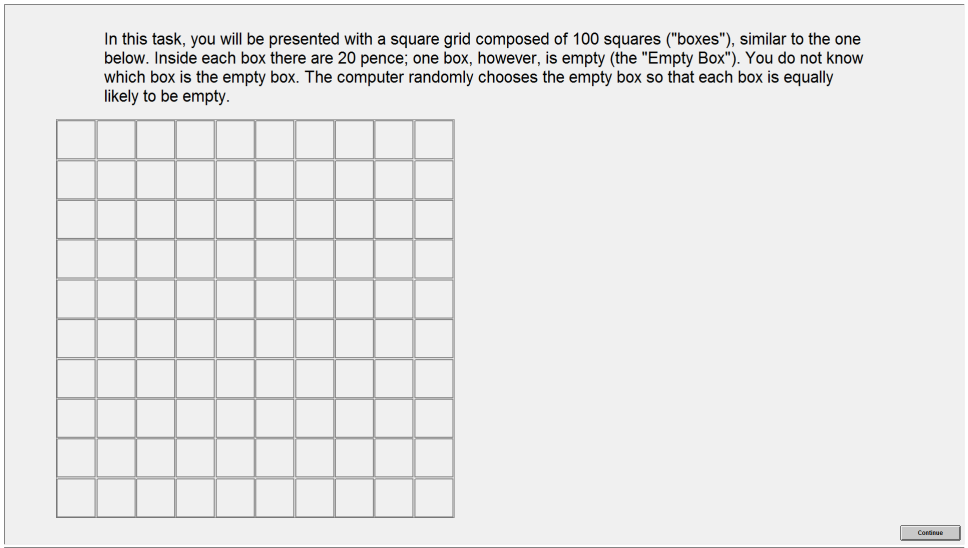
The ratio between the length of the second and fourth digit (2D:4D) has been proposed to be a stable marker in adults of their prenatal exposure to androgens. Moreover, the 2D:4D of financial professionals is known to correlate with the trader's years of experience as well as their earnings (Coates et al., 2009). We recorded this measure based on photocopies of the participants' right hands.

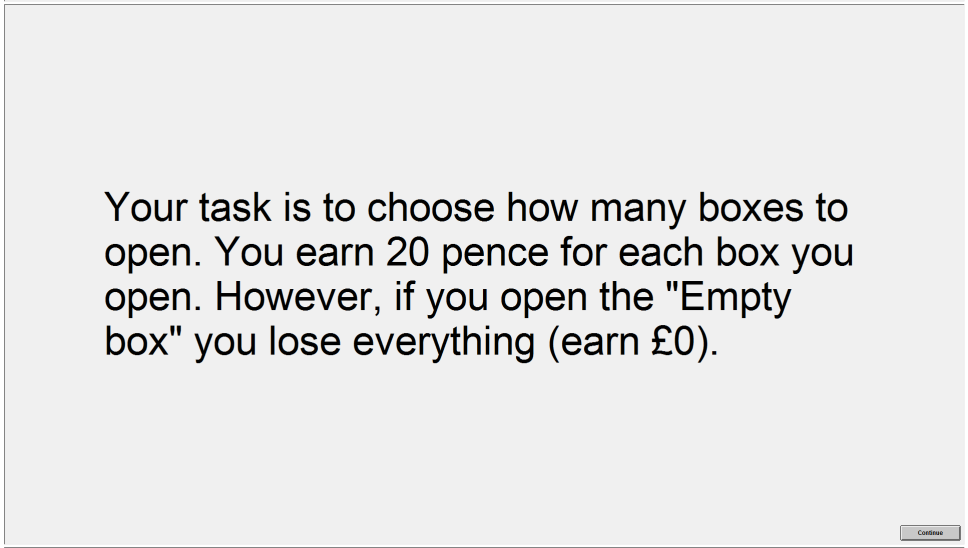
6.5 Grit, Locus of Control, Self-Monitoring, Big-5 Personality Traits

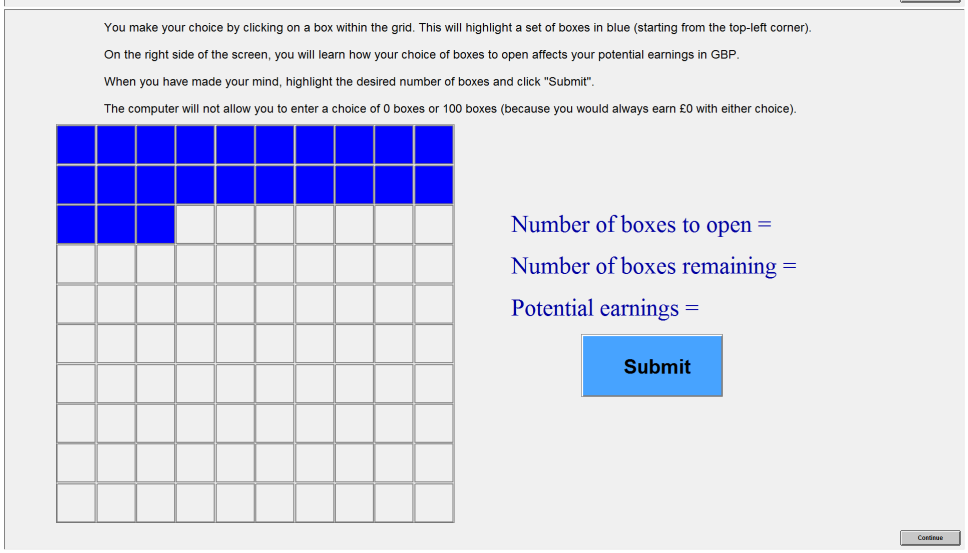
We asked participants to answer a series of questions, to test non-cognitive abilities. We gathered data on each of the well-known Big-5 personality traits. The 'Big Five' taxonomy measures personality traits for Openness (to experience), Conscientiousness, Extroversion, Agreeableness, and Neuroticism. In our study, we use the 10-item Big-5 inventory (Rammstedt and John, 2007).

Participants were asked to report the level of "Grit" they possess. Examples of Grit questions are: "I have been obsessed with a certain idea or project for a short time but later lost interest." and "I have difficulty maintaining my focus on projects that take more than a few months to complete". Participants have to answer whether they "Agree strongly" or "Disagree strongly" about how this sentence describes them (with three gradations in between those end points). In our study, we use the 8-item GRIT-S scale (Duckworth and Quinn, 2009). Participants were also asked to report their level of "Locus of Control" (LoC) in their life. Examples of LoC questions are: "There is little I can do to change many of the important things in my life" and "What happens to me in the future mostly depends on me". Participants have to answer whether they "Agree strongly" or "Disagree strongly" about how this sentence describes them (with three gradations in between those end points). We use the 7 LoC questions in Cobb-Clark and Schurer (2013) which were used as part a longitudinal study on household income and labor dynamics in Australia ("HILDA Survey"). The 25 questions used for the Big 5, Grit, and LoC are in section 6.7. Finally, participants were asked to report their level of "Self-Monitoring" they possess. Examples of self-monitoring questions are: "I find it hard to imitate the behavior of other people" and "I may deceive people by being friendly when I really dislike them". We measure this experimentally using a series of 18 true/false questions that make up the Self-monitoring scale (Snyder and Gangestad, 1986). This task is shown section 6.8.

6.6 Bomb Risk Elicitation Task (BRET)





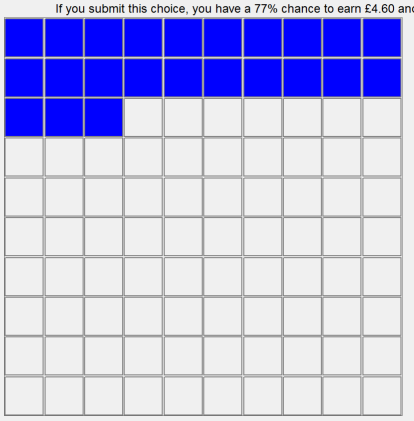


After you have submitted your choice, your earnings will be calculated.

For example, consider the choice below. (The grid and Submit button are deactivated for these instructions)

This choice is to open boxes 1-23. If the Empty Box is one of boxes 1-23, you will earn £0. However, if the Empty Box is one of boxes 24-100, you will earn £4.60.

If you submit this choice, you have a 77% chance to earn £4.60 and a 23% chance to earn £0.



Number of boxes to open = 23

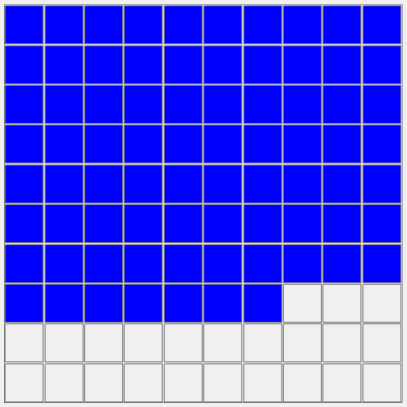
Number of boxes remaining = 77

Potential earnings = £4.60

Submit

Continue

Please select the number of boxes you want to open. Your choice will determine how much you are paid. After you are satisfied with your choice, please click Submit.



Number of boxes to open = 77

Number of boxes remaining = 23

Potential earnings = £15.40

Submit

You opened 77 boxes (box 1 through box 77)

The Empty box is box 27

You opened the Empty box

Therefore your earnings for this task are £0.00

OK

6.7 Big-5, Grit, and LoC questions

Station #_____

How I am in general

Listed below are a number of statements that may or may not apply to you. For example, do you agree that you are someone who *likes to spend time with others*? Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement.

1 Disagree Strongly	**2** Disagree a little	**3** Neither agree nor disagree	**4** Agree a little	**5** Agree strongly

(1) _____ I am reserved

(2) _____ I am generally trusting

(3) _____ Setbacks don't discourage me

(4) _____ I tend to be lazy

(5) _____ I am relaxed, I handle stress well

(6) _____ I finish whatever I begin

(7) _____ I have few artistic interests

(8) _____ I have an active imagination

(9) _____ I do a thorough job

(10) _____ I get nervous easily

(11) _____ I am diligent

(12) _____ I tend to find fault with others

(13) _____ I am outgoing, sociable

(14) _____ I am a hard worker

(15) _____ I have little control over the things that happen to me

(16) _____ I often set a goal but later choose to pursue a different one

(17) _____ There is really no way I can solve some of the problems I have

(18) _____ New ideas and projects sometimes distract me from previous ones

(19) _____ I often feel helpless in dealing with the problems of life

(20) _____ Sometimes I feel that I'm being pushed around in life

(21) _____ I have been obsessed with a certain idea or project for a short time but later lost interest

(22) _____ What happens to me in the future mostly depends on me

(23) _____ There is little I can do to change many of the important things in my life

(24) _____ I have difficulty keeping my focus on projects that take more than a few months to complete

(25) _____ I can do just about anything I really set my mind to do

6.8 Self-Monitoring questions

How I am in general (continued)

As on the previous page, this page lists a number of statements that may or may not apply to you. If a statement is true or mostly true as applied to you, make a mark in the "True" column as your answer. If a statement is false or not usually true as applied to you, make a mark in the "False" column as your answer. Please record your answers in the spaces provided below.

	True	False
I find it hard to imitate the behaviour of other people.		
At parties and social gatherings, I do not attempt to do or say things that others will like.		
I can only argue for ideas which I already believe.		
I can make impromptu speeches even on topics about which I have almost no information.		
I guess I put on a show to impress or entertain others.		
I would probably make a good actor.		
In a group of people I am rarely the centre of attention.		
In different situations and with different people, I often act like very different persons.		
I am not particularly good at making other people like me.		
I'm not always the person I appear to be.		
I would not change my opinions (or the way I do things) in order to please someone or win their favour.		
I have considered being an entertainer.		
I have never been good at games like charades or improvisations.		
I have trouble changing my behaviour to suit different people and different situations.		
At a party I let others keep the jokes and stories going.		
I feel a bit awkward in public and do not show up quite as well as I should.		
I can look anyone in the eyes and tell a lie with a straight face.		
I may deceive people by being friendly when I really dislike them.		

6.9 CRRA values for BRET

Table A.2: Estimates of γ for BRET, assuming CRRA u(c) $= \frac{c^{(1-\gamma)}}{1-\gamma}$

# boxes	γ	# boxes	γ	# boxes	γ
1	> 0.985	34	[0.496; 0.473)	67	[-0.985; -1.077)
2	[0.985; 0.974)	35	[0.473; 0.450)	68	[-1.077; -1.175)
3	[0.974; 0.964)	36	[0.450; 0.425)	69	[-1.175; -1.279)
4	[0.964; 0.953)	37	[0.425; 0.400)	70	[-1.279; -1.390)
5	[0.953; 0.942)	38	[0.400; 0.374)	71	[-1.390; -1.509)
6	[0.942; 0.930)	39	[0.374; 0.347)	72	[-1.509; -1.636)
7	[0.930; 0.919)	40	[0.347; 0.319)	73	[-1.636; -1.774)
8	[0.919; 0.907)	41	[0.319; 0.291)	74	[-1.774; -1.922)
9	[0.907; 0.895)	42	[0.291; 0.261)	75	[-1.922; -2.082)
10	[0.895; 0.883)	43	[0.261; 0.230)	76	[-2.082; -2.255)
11	[0.883; 0.870)	44	[0.230; 0.198)	77	[-2.255; -2.444)
12	[0.870; 0.857)	45	[0.198; 0.165)	78	[-2.444; -2.651)
13	[0.857; 0.844)	46	[0.165; 0.131)	79	[-2.651; -2.878)
14	[0.844; 0.830)	47	[0.131; 0.095)	80	[-2.878; -3.128)
15	[0.830; 0.817)	48	[0.095; 0.058)	81	[-3.128; -3.405)
16	[0.817; 0.802)	49	[0.058; 0.020)	82	[-3.405; -3.714)
17	[0.802; 0.788)	50	[0.020; -0.020)	83	[-3.714; -4.061)
18	[0.788; 0.773)	51	[-0.020; -0.062)	84	[-4.061; -4.452)
19	[0.773; 0.758)	52	[-0.062; -0.105)	85	[-4.452; -4.897)
20	[0.758; 0.742)	53	[-0.105; -0.151)	86	[-4.897; -5.407)
21	[0.742; 0.726)	54	[-0.151; -0.198)	87	[-5.407; -6.000)
22	[0.726; 0.710)	55	[-0.198; -0.247)	88	[-6.000; -6.696)
23	[0.710; 0.693)	56	[-0.247; -0.299)	89	[-6.696; -7.524)
24	[0.693; 0.675)	57	[-0.299; -0.353)	90	[-7.524; -8.526)
25	[0.675; 0.658)	58	[-0.353; -0.410)	91	[-8.526; -9.765)
26	[0.658; 0.639)	59	[-0.410; -0.469)	92	[-9.765; -11.333)
27	[0.639; 0.621)	60	[-0.469; -0.532)	93	[-11.333; -13.385)
28	[0.621; 0.601)	61	[-0.532; -0.597)	94	[-13.385; -16.182)
29	[0.601; 0.582)	62	[-0.597; -0.667)	95	[-16.182; -20.222)
30	[0.582; 0.561)	63	[-0.667; -0.740)	96	[-20.222; -26.571)
31	[0.561; 0.540)	64	[-0.740; -0.817)	97	[-26.571; -38.000)
32	[0.540; 0.519)	65	[-0.817; -0.899)	98	[-38.000; -64.666)
33	[0.519; 0.496)	66	[-0.899; -0.985)	99	$<$ -64.666