Essays on the Effort Provision of People Under the Presence of Risky and Ambiguous Shocks

Vincent (Philip) Melnikov

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Abstract

This thesis investigates how people exert effort in environments where shocks occur that increase or decrease the time cost of effort that is required of them in order to complete a series of tasks.

Chapter 1 examines how individuals exert effort when the possibility of a negative shock is present that will increase the time cost of effort of engaging in a real-effort task. We conduct an experiment in which participants engage in ten rounds of a task that is split into two sections of five rounds. The first five rounds have the same time cost for all participants, with the second five rounds having a chance of having either a greater or same time cost. Our treatments determine the level of information that participants receive about the probability of the negative shock occurring. Our treatments are full information, risk and ambiguity. Participants in the full information treatment know upfront the time cost of all rounds in both sections. In the risk treatment, participants are told that there is a 50/50 chance of the shock occurring. In the ambiguity treatment, participants are told that there is some unspecified chance of the shock occurring. Our findings suggest that participants in the full information and ambiguity treatments exert similar effort, with participants in the risk treatment exerting significantly less effort.

Chapter 2 looks at how individuals exert effort when the potential shock to time cost of effort is positive. We use a similar design for our experiment as in chapter 1 with the shock now decreasing the time cost of effort rather than increasing it. Our treatment groups for this experiment are risk and ambiguity. Our findings suggest that when the potential shock is positive, participants in both the risk and ambiguity treatments exert similar levels of effort, seemingly unaffected by the level of information provided to them.

Chapter 3 compares the results of chapters 1 and 2, aiming to determine whether there is a reference point effect in how people exert effort based on whether the shock is negative or positive. We suggest that relative differences between the behaviours of participants in the risk and ambiguity treatments are primarily caused by the framing of the outcomes. We find that in the domain of gains, there are no significant differences between the two treatments, indicating that participants treated risk the same as they did ambiguity. In the domain of losses, we find that participants in the ambiguity treatment are more likely to engage with the task and take on the time costs of effort.

Access Condition and Agreement

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Introduction

This thesis looks into how people exert effort in environments where the effort cost of time can change due to risky or ambiguous shocks. We use experimental methods and implement an online study in order to answer our research questions. The thesis consists of three chapters: the first chapter examines how negative risky and ambiguous shocks affect effort provision through an experiment; chapter two examines how positive risky and ambiguous shocks affect effort provision through a second experiment; the third chapter compares the results of the prior two chapters to determine whether there are reference point effects based on whether participants experience positive or negative shocks.

In the first chapter we look at how people choose to exert effort when there are uncertainties about the time cost of effort. Effort provision can be impacted by a number of different factors, chief among them being monetary payouts (DellaVigna and Pope, 2018). However, while monetary incentives may motivate effort, effort itself is rarely costless (Inzlicht et al, 2018). Chief among these costs is the time that has to be spent engaging in effort, with the presence of outside options making it more difficult for people to exert effort (Otto and Daw, 2019; Erkal et al., 2018; Goerg et al., 2019).

However, people may not always have perfect knowledge about how long they will need to work, and outside factors may affect time costs. While uncertainties are commonly studied in the effort literature, the focus is mainly on uncertainties around payoffs and uncertainties concerning worker effort in principal agent models (Dalton et al., 2016; Rubin and Sheremeta, 2015; List & Rasul, 2011). We aim to contribute to the literature on effort by examining how uncertainties around time costs of effort affect effort provision. Specifically, we compare how effort provision differs in risky and ambiguous environments.

Given the literature on perseverance, grit and resilience we speculate that some participants may be less impacted by the shocks to their time cost of effort and therefore may respond less to our treatment, causing heterogeneity in treatment effects. We therefore conduct an exploratory analysis on whether perseverance scores obtained through the Grit S measure have an effect on the effort provision within treatments and investigate any heterogeneity in treatment effects.

We conduct an online experiment in which participants work on an effort task adapted from Gill and Prowse (2012) and DellaVigna and Pope (2018) that requires continued

alternating presses of the “A” and “K” keyboard buttons. In order to receive a bonus payment participants have to complete 10 rounds of this task. For all participants, the first five rounds are 1-minute each, with the second 5 rounds having either rounds that are 1-minute or 3-minutes each.

Our treatments vary the level of information participants receive about the probability of rounds in the second set of 5 rounds being longer. We have a full information treatment where participants have perfect knowledge about the length of all 10 rounds. The risk treatment tells participants that there is a 50/50 chance of the second set of 5 rounds being longer, and the uncertainty treatment states that there is an unknown chance of the rounds being longer in the second set. Our findings suggest that participants who do not know the probabilities behave in the same way as those who have perfect information. When probabilities are known to participants, they exert significantly less effort than the other two treatments. Our exploratory analysis on the effects of perseverance on effort suggests that perseverance does not have a significant effect on how people react to the level of information provided about shocks occurring.

In the second chapter, we investigate whether effort provision is impacted when shocks can decrease the cost of effort, therefore making it easier to exert effort. Expectations play a role in how much effort people choose to exert, with expectations of higher payoffs yielding greater effort (Abeler et al., 2011). While monetary incentives drive a large part of effort (Dellavigna and Pope, 2018), this effort has a cost often in the form of opportunity cost (Otto and Daw, 2019; Erkal et al., 2018; Goerg et al., 2019). It stands to reason that expectations about the length of time that a task takes can influence how much effort a person will exert, since less time cost means lower opportunity cost.

We therefore investigate how uncertainties about whether a positive shock that will decrease the time cost of effort will influence how much effort an individual will exert. With differing levels of information about the probability of the shock occurring, we reason that people may behave differently. Chiefly we investigate whether there is a difference in effort depending on whether people know the probability of having a lower cost in the future or whether those probabilities are ambiguous. We expect that due to ambiguity aversion people will exert greater effort when probabilities are known.

In order to test our hypothesis, we conduct an online experiment where participants engage in 10 rounds of a real effort task based on the task developed by Gill and Prowse

(2012). The first 5 rounds require participants to work for 2-minutes in each round, with the second 5 rounds having a probability of shorter rounds. Our treatments differ from each other in the level of information that participants are provided about the probability of having shorter rounds. In the risk treatment, participants are told that there is a 50/50 chance of having shorter rounds; in the ambiguity treatment, participants are not told what the exact probabilities are. Participants are incentivised to complete all 10 rounds with a conditional bonus payment on full completion. However, they are given the option of skipping to the end of the experiment at any point, therefore providing them with an outside option that forgoes the bonus payment.

Counter to what we expected, we find that participants in both the risk and ambiguity treatments exert similar amounts of effort when there is the possibility of a shock occurring that decreases effort. We also find that participants who are more ambiguity averse exert less effort in the risk treatment but more effort in the ambiguity treatment.

In our third chapter, we investigate whether there are reference point effects on effort under uncertain conditions. How people choose to exert effort can be dictated by how they perceive outcomes (Abeler et al., 2011). Such reference effects are frequently seen in how people make decisions, with people acting differently based on whether they perceive outcomes to be negative or positive (Rigoli, 2019; Eil & Rao, 2011; Kőszegi & Rabin, 2006). Furthermore, these decisions can be affected depending on whether outcomes have known or unknown probabilities, with people generally preferring known probabilities (Machina and Siniscalchi, 2014; Weber & Tan, 2012).

Existing literature on effort focuses on effort provision in uncertain environments when uncertainties are present about ability or outcomes such as in principal agent problems. Furthermore, this literature frequently presents uncertainties in terms of ambiguity where probability is not known, or risk where probabilities are known but does not compare how effort provision differs between the two. We wish to contribute to the literature by exploring the differences that exist between effort provision when uncertainties about the time cost of effort are present and determine whether there are reference point effects based on whether people are in the positive or negative domain.

To answer our questions, we compare the results from our prior two chapters. Chapter 1 explored how effort is affected when people can experience negative shocks that increase the time cost of effort. Chapter 2 looked at a similar environment but with the

possibility of positive shocks that decrease the time cost of effort for people. Because the experimental designs of the two chapters mirror each other closely, we first compare general effort levels between the two domains in each of the treatments, then looking at between treatment differences across the two experiments.

Our findings suggest that in general, people exert more effort in the domain of losses when probabilities are not known and exert similar effort between both domains when probabilities are known. People exhibit greater effort under ambiguity in the domain of losses, implying ambiguity seeking behaviour, while exerting similar effort to risk in the domain of gains. This finding is consistent with the literature that states that people tend to be more ambiguity averse in the domain of gains than the domain of losses (Cohen et al., 1987).

Chapter 1

What you don’t know won’t hurt you:
Effort under risky and ambiguous shocks

1.1 Introduction

In daily work, effort provision is an integral component to success, with effort often needing to be consistently exerted over a period of time in order to achieve a goal or complete a project. An individual's effort provision can be impacted by a number of different factors, motivating them to work harder or having the opposite effect (DellaVigna & Pope, 2018). One important consideration is how costly it is to exert effort. In particular, opportunity costs can make it more difficult to work as outside options are more attractive (Inzlicht et al, 2018; Otto and Daw, 2019; Erkal et al., 2018; Georg et al., 2019).

However, opportunity costs may not always remain constant, with some uncertainties present around events that may increase the time needed to work. As such events are outside of the individual's control, they must contend with the uncertainties and allocate effort based on the information that they have. In such cases the level of information may have a significant impact on how much effort is exerted. Specifically, people may behave differently if they know the probability of an adverse event occurring that will increase the time cost of effort than if the probability is ambiguous. It is therefore important to understand how such decisions are made and how environments of risk and ambiguity affect effort provision in order to foster greater productivity.

To illustrate the idea, we can imagine a classic case of where a student is required to work on a group project. Inherently most hard-working students are aware that there is some chance that a group member will not do their part, requiring them to put in more work. In some cases however, the student may be aware of a particular individual's reputation and thus have a better idea of how likely they are to do their part. Depending on which case we consider, the student may behave differently and choose to allocate different levels of effort.

How people exert effort under risk and ambiguity is frequently studied in the effort literature with a focus on uncertainties in payoffs and uncertainties in principal agent environments (Dalton et al., 2016; Rubin and Sheremeta, 2015; List & Rasul, 2011). There is a gap in the literature regarding how people choose to exert effort when there are time cost uncertainties, and importantly comparing effort between risk and ambiguity.

The risk and ambiguity literature commonly looks at decisions in terms of lottery-like decisions and does not provide insight into choices regarding effort (Ellsberg, 1961; Di Mauro & Maffioletti, 2004). We therefore investigate how people exert effort in environments that feature risky or uncertain shocks that affect how costly it is to exert effort rather than the monetary payoffs. Our research question focuses on whether there are differences in the amount of effort that people exert in risky versus uncertain environments.

We know that people tend to exhibit ambiguity aversion (Ellsberg, 1961; Di Mauro & Maffioletti, 2004; Machina and Siniscalchi, 2014; Weber & Tan, 2012), meaning that people prefer environments where the probabilities are known. We therefore speculate that when a negative shock can increase the time cost of effort, people will be less likely to exert effort when the probability of this shock is ambiguous rather than risky.

A wide range of literature in psychology and behavioural economics suggests that some people may be more likely to work through setbacks and hardships due to personality traits such as perseverance, grit and resilience (Eskreis-Winkler et al., 2014, Duckworth et al., 2007 Vella & Pai, 2019; Fletcher and Sarkar, 2013; Herrman et al., 2011). We therefore speculate that different levels of perseverance (as a psychological trait) in an individual may affect the amount of effort that people will exert, with some being able to continue exerting effort after an adverse shock better than others.

To determine whether there are differences in effort provision based on whether probabilities about a negative event occurring are known or not, we conducted an online experiment. This experiment featured ten rounds of a real-effort task, with participants earning a bonus if they complete all ten rounds. The way in which we introduce the negative shock is by changing the amount of time that each round of the task lasts.

Splitting the 10 rounds into two sections of 5, we fix the first 5 rounds at 1-minute each, while the second 5 rounds can either be 1 or 3-minutes. We inform participants of this general structure within our treatments before they start the rounds, and vary the level of information that they receive about the probability of the rounds being 1 or 3 minutes. The treatments are full information, risk and ambiguity. In the full information participants know the length of rounds in both sections, while in the risk and ambiguity treatment they are either told that there is a 50/50 chance of rounds being longer or some chance of longer rounds respectively.

We find that individuals who expect a negative shock with a known probability (risk) are less likely to engage in and subsequently complete all ten rounds compared to individuals who expect a negative shock with an unknown probability (ambiguity) or those who have full information. This effect is primarily driven by individuals who know the probabilities of the shock occurring choosing not to enter and complete the first round of the task.

An exploratory analysis on whether a participant's perseverance has an impact on how they are affected by the treatment was conducted as well. We find that perseverance scores do not have a significant effect on effort provision and do not impact treatment effectiveness.

1.2 Literature review

effort provision

Literature on effort provision is wide spanning with research looking at how people are motivated to exert effort as well as how people exert effort in different circumstances. In general, people are most motivated by monetary payoffs (DellaVigna & Pope, 2018; Erkal et al., 2018). DellaVigna & Pope (2018) provided important insight into different factors that motivate people to exert effort that is costly. While monetary incentives were found to be very effective as expected, they also found that psychological factors and behavioural models are motivators and affect effort, but not as much as monetary incentives and not always as predicted by prior studies.

When looking at costs, research has found that not only are people's preferences for how to allocate effort can change (Augenblick et al., 2015), but that intrinsic costs can influence effort provision as well (Goerg et al., 2019). Further, time costs are shown to be a significant effort cost with people choosing not to exert effort when the cost is high (Otto & Daw, 2019).

Relatedly, Abeler et al. (2011) show that an individual's effort is dependent on expectations through a reference point effect. Specifically, they show that subjects tend to work on a real-effort task longer when their expectations of payment were higher than those subjects whose expectations were lower. Other studies find similar findings in that how much effort people choose to exert can be dependent on their expectations and perceptions about success (Gill & Prowse, 2012; Bushong & Gagnon-Bartsch 2023; Burke et al., 2023).

This further supports the idea that people will exert more effort when they have positive expectations about outcomes; we contribute to the literature on effort provision by exploring how exactly people exert effort when they are faced with ambiguous versus risky shocks that will increase the time cost of effort.

risk and ambiguity, shocks, and productivity

Risk and ambiguity are two distinct concepts relating to events that are probabilistic in their occurrence. Risk is defined as an environment where the probabilities of an event occurring are known, whereas ambiguity is when the probabilities are unknown. Starting with Ellsberg in 1961, evidence suggests that people react differently to risk versus ambiguity and tend to prefer risk, this is termed ambiguity aversion. More recent papers have expanded on the literature with similar general findings that people tend to prefer risk over ambiguity in a variety of contexts (Machina and Siniscalchi, 2014; Weber & Tan, 2012; Halevy, 2007; Chow & Sarin, 2000; Halvey & Feltkamp, 2005). Some differences are seen in certain contexts of framing, like in Coutts et al. (2023) who find that people who feel lucky are more likely to be ambiguity seeking.

Literature on shocks and productivity tend to focus on principal agent environments where the principal has limited information on the shocks that interrupt the agent's performance (Rubin and Sheremeta, 2015). In their experiment they use a gift exchange game where principals choose a wage and desired effort for agents, who then receive the wage and choose their effort. When they introduce a random shock component that modifies the effort of agents, wages and effort offered by principals decreases and makes agents provide lower effort. These findings suggest that the introduction of shocks that make the outcomes of effort provision uncertain causes agents to lower their effort since there is a chance greater effort will not result in a better outcome.

Through our research, we wish to expand on the literature on effort provision by exploring how individuals allocate effort when they are presented with risky vs ambiguous shocks that can increase the time cost of effort of engaging in a task. We also contribute to the literature on risk and ambiguity by providing insight into how people react to the two environments in the domain of real effort.

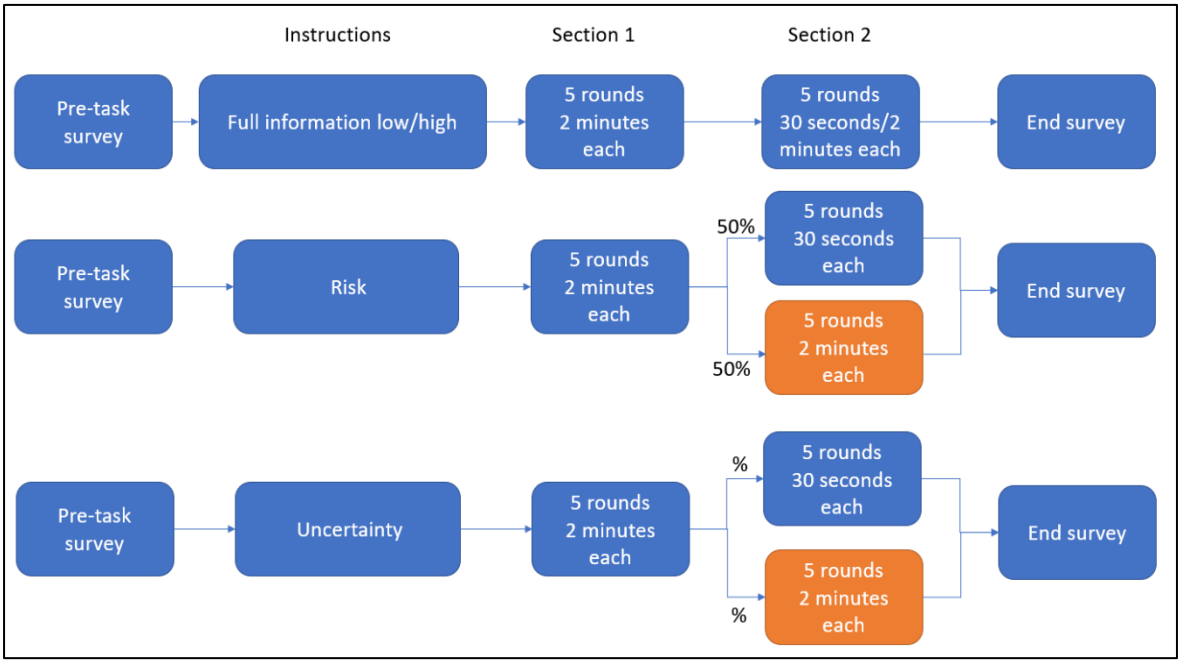
1.3 Experimental design

Treatments

The general structure of the experiment features ten rounds of a real effort task. The rounds are split into two sections of five rounds each. Figure 1.1 uses a flowchart to describe the structure of each treatment. Participants are incentivised to complete all ten rounds with an all or nothing bonus payment. Participants can quit working on the rounds at any time, therefore foregoing the bonus payment.

The experiment contains three between subject treatments: full information, risk, and ambiguity. In the full information treatment, subjects have complete information as to

Figure 1.1 – General structure of experimental design



Notes: The figure shows the general structure of the experiment. It is split into three horizontal flowcharts, one for each of the treatments. The first flowchart displays the structure of the Full information treatment. In this treatment, participants have a 50% chance of being assigned into the high or low outcome of the treatment and learn the state of the world right away, having full information as to the length of the rounds. The second flowchart shows the structure of the risk treatment, where participants are told that there is a 50% chance that the second 5 rounds will each be longer. The third flowchart shows the structure of the ambiguity treatment where participants are told that there is some chance of the second 5 rounds being longer.

the length of the rounds in both sections. Through random assignments participants in the full information treatment will have a 50% chance of either having 1-minute rounds in section 1 and 1-minute rounds in the second section or having 1-minute rounds in section 1 and 3-

minute rounds in the second section. This treatment serves as a control group for subject's behaviour when they have full information about the state of the world in the second section of the task.

In the risk treatment, subjects are aware that they will have 1-minute rounds in section 1 but are also told that there is a 50% probability of rounds in section 2 being either 1-minute or 3-minutes long. This mirrors the control group, except that the event only occurs after section 1 is complete, rather than before section 1 starts. Therefore, subjects know the explicit probability of a negative shock occurring that will increase the time cost of effort.

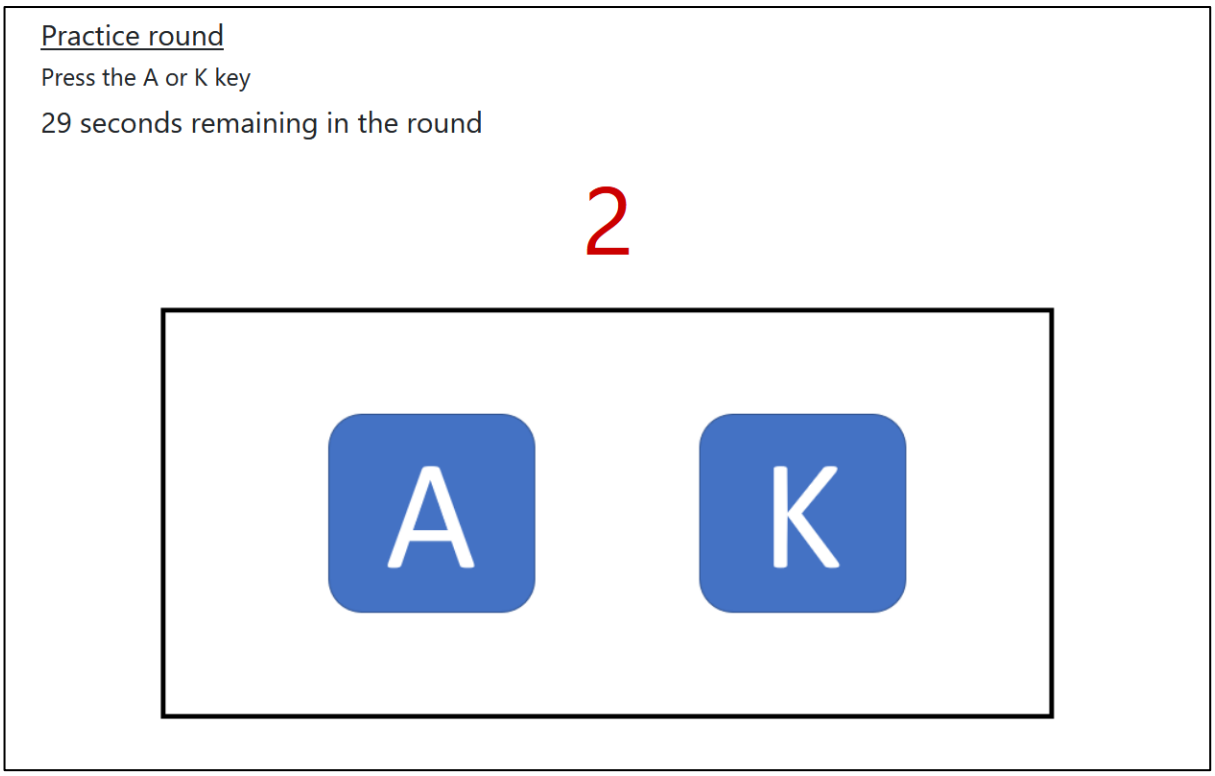
In the ambiguity treatment, subjects are told that there is some probability that the rounds in section 2 will be 3-minutes long, and some probability that the rounds will remain 1-minute long. The true probability remains at 50% as in the risk treatment. As subjects do not know the explicit probability of either state of the world, the probability of the shock will remain uncertain.

The task

Subjects work on a simple key-press task where they are required to alternately press the 'A' and 'K' keys on their keyboards. Subjects have 3 seconds between each button press to press the next key, ensuring that they exert continuous effort throughout the duration of the task round. A timer is displayed on the screen, counting down from 3 and refreshing upon the subject pressing the appropriate button (Figure 1.2).

If subjects fail to press the appropriate button (the next button in the sequence, i.e., pressing 'K' after having pressed 'A' or vice versa) then the task round is considered incomplete and subjects are notified that they have unsuccessfully completed the task rounds of the experiment, they do not receive the bonus payment, and proceed to the end survey questions of the experiment.

Figure 1.2 – An example of the task screen as participants see it



Notes: The figure shows the screen that participants will see when they are working on the real-effort task. In the top left corner is the title of the round as well as the round countdown. In the middle of the screen is the larger red countdown for the task which counts down from 3 to 0. Below that is an imagine that shows participant the next key which they must press. When participants press either the A or K key that key will become greyed out, indicating that this key has been pressed.

A critical component of the experiment is that subjects have the ability to skip the main task rounds and proceed to the end survey section of the experiment at any point at the cost of the bonus payment (i.e., before each round and during each round). If a subject chooses to do so, they still receive the participation fee upon completing all of the final survey questions.

Rounds are presented sequentially and failing a round at any point will mean that the participant will not move on to the next round, so the bonus is only received upon completion of round 10. This incentivises participants to commit consistent effort to the task throughout the rounds. As the experimental task is intentionally made simple and dull, the prospect of skipping the task rounds and effort needed to exert is made an attractive option. Our outcome variable, therefore, is the number of rounds that subjects have completed (in other words, how long subjects lasted during the task rounds).

The experiment was programmed using oTree and participants were recruited using Prolific. A UK sample balanced on gender was used, a balance table of relevant variables is presented in Table 1.1. Throughout the experiment we implemented intermittent attention checks to ensure that participants were reading instructions and not just clicking through the screens. Additionally, we implemented two different comprehension tests that made sure

Table 1.1 – Balance table for relevant variables by treatment

	(1) Full information treatment	(2) Risk treatment	(3) Ambiguity treatment
Age	40.31	41.26	40.69
	(12.92)	(13.89)	(14.51)
sex==Female	0.49	0.48	0.52
	(0.50)	(0.50)	(0.50)
sex==Male	0.51	0.52	0.48
	(0.50)	(0.50)	(0.50)
keys_total	2333.60	1992.36	2291.54
	(2073.47)	(1972.80)	(1768.60)
perseverance	3.27	3.33	3.26
	(0.70)	(0.74)	(0.67)
risk_measure	11.02	10.43	10.36
	(5.56)	(4.76)	(5.35)
imi_measure	2.86	2.80	2.84
	(0.46)	(0.45)	(0.50)
N	152	147	145

Notes: The balance tables shows the variables for Age (a continuous variable), sex (male and female sowing with numbers indicating the proportion of each in the sample), total rounds completed (the mean number out of 10), total key presses that participants made (shown as a mean), their perseverance score (mean score out of a maximum of 5, with 5 indicating the highest perseverance score), and risk measure (a measure from 0-30 with numbers below 15 indicating risk aversion).

participants understood the instructions for the task and the general round and treatment structure respectively.

In total, 444 participants were recruited (220 female). The majority of participants reported that they were white (382) with the next highest ethnicity being Asian (21). Participants had a median age of 38 (18-90). Sessions were run during the month of November in 2022. Average time taken to complete the experiment was about 30 minutes. Subjects received £3.00 for participation upon completing the experiment in its entirety, with a potential for earning £2.02 in bonus payments. Participants received a mean payoff of £4.30 with a median payoff of £5.02.

Surveys

Before subjects begin working on the task, we first elicit measures of risk aversion and perseverance through surveys at the beginning of the experiment. The reason for having these elicitations at the beginning of the experiment is two-fold. First, we have these survey measures before the experiment in order to combat any consistency preferences that subjects may have. A potential disadvantage of having risk and perseverance elicitation surveys before the task is that it might prime individuals to put in more or less effort into the task based on their answers to the survey questions. However, it would be costly for a subject to match their survey answers to their actions. If the survey questions came after the task, it would be much less costly to match their answers to their decisions.

The surveys themselves are the risk elicitation survey from the preference survey module developed and experimentally verified by Falk et al. (2016), the perseverance portion of the Grit S scale developed by Duckworth and Quinn (2009), the intrinsic motivation index from Ryan (1982) and several survey questions pertaining to the experiment and the subject's willingness to engage in additional rounds of the experiment.

1.4 Hypotheses

H1: Due to ambiguity aversion, when shocks that will increase time cost of effort have an ambiguous probability of occurring, participants will have the lowest effort provision out of the three treatments.

This hypothesis draws on the literature of ambiguity aversion. The findings suggest that people prefer known probabilities rather than unknown probabilities. When people don't know the probability of a negative event, they will tend to place greater weight on the negative outcome (Machina and Siniscalchi, 2014; Weber and Tan, 2012; Cohen et al., 1987).

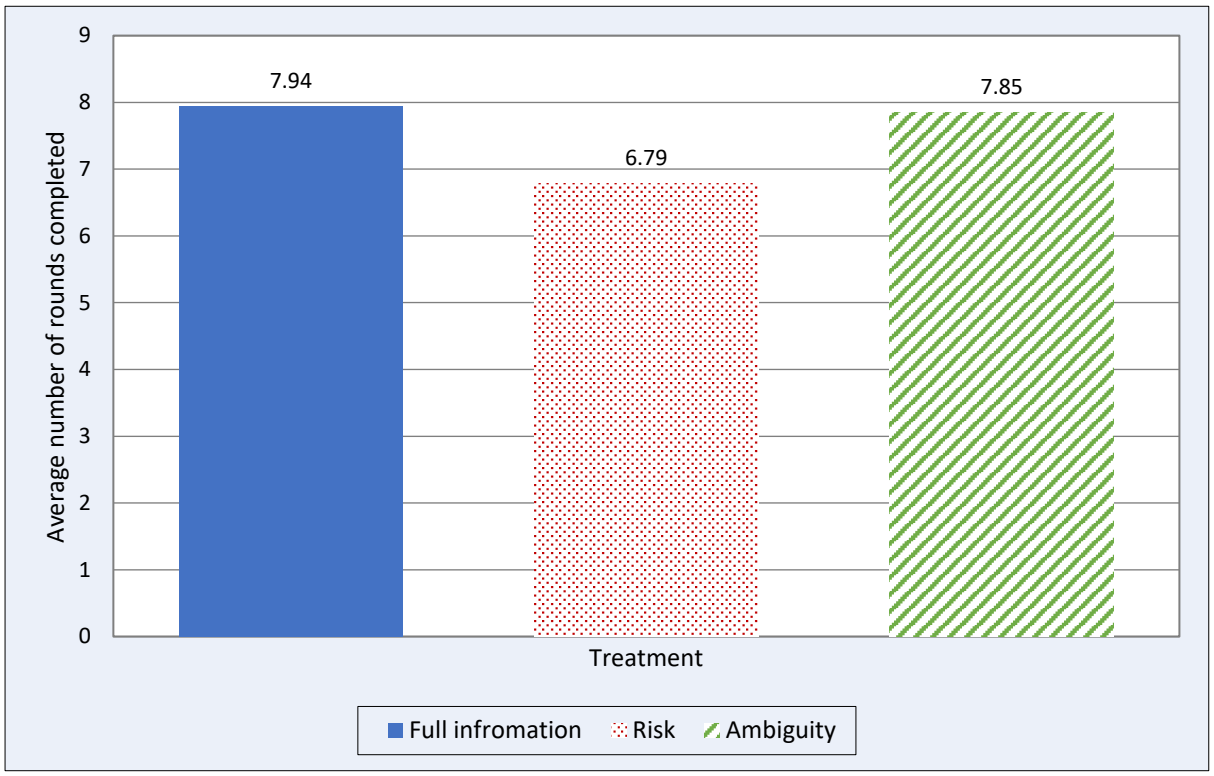
H2: Participants in the full information treatment will have the highest effort provision, followed by participants in the risk treatment on average.

This hypothesis is developed from the idea that with full information, participants will be able to commit to a given level of effort more easily, as expectations can affect effort (Abeler et al., 2011; Rubin and Sheremeta, 2015).

1.5 Results

Across all treatments, the average number of rounds completed was 7.5. In the full information treatment participants completed an average of 7.9 rounds. In the risk treatment participants had a mean completion of 6.79 rounds and in the ambiguity treatment participants had a mean completion of 7.8 rounds. On average we see that participants in the risk treatment complete about one fewer round than participants in the other two

Figure 1.3 – Mean number of rounds participants completed by treatment number



treatments[1]. Figure 1.3 shows a graph of the mean number of rounds passed by treatment.

Looking at figure 1.3, it would appear that our H1 hypothesis that ambiguity would have the lowest level of effort provision will be rejected. In line with our H2, the full information treatment does have the highest effort provision by a small margin. It is closely followed by ambiguity. Usings t-tests, we find that there are significant differences between the full information treatment and ambiguity treatment (p=0.0106) as well as between risk

[1] Participants in the Full information made an average of about 2333 key presses, with participants in the risk and ambiguity treatments making an average of about 1992 and 2291 key presses respectively.

and ambiguity (p=0.0178). No significant differences are present between full information and ambiguity.

Table 1.2 – OLS regression using the total number of rounds passed as the dependent variable

	model 1	model 2	model 3	model 4	model 5	model 6	conditional model
Risk	-1.152***	-1.154***	-1.158***	-1.168***	-1.186***	-0.986**	-0.490
	(0.431)	(0.432)	(0.433)	(0.433)	(0.435)	(0.410)	(0.361)
Ambiguity	-0.0925	-0.0954	-0.0936	-0.0911	-0.0878	-0.0148	-0.182
	(0.433)	(0.434)	(0.434)	(0.435)	(0.437)	(0.412)	(0.352)
Constant	7.941***	7.990***	8.076***	7.455***	7.511***	0.620	3.151***
	(0.302)	(0.481)	(0.536)	(0.996)	(1.073)	(1.362)	(1.213)
Risk measure		-0.00443	-0.00636	-0.00589	-0.00644	-0.00855	-0.000733
		(0.0339)	(0.0344)	(0.0344)	(0.0349)	(0.0329)	(0.0286)
Female			-0.131	-0.123	-0.127	-0.328	-0.550*
			(0.359)	(0.359)	(0.362)	(0.342)	(0.297)
Perseverance measure				0.187	0.189	-0.0991	-0.0396
				(0.253)	(0.264)	(0.251)	(0.221)
Age					-0.000942	0.000739	0.000558
					(0.0137)	(0.0129)	(0.0113)
Intrinsic motivatoin index						2.754***	2.008***
						(0.366)	(0.321)
Observations	444	444	444	444	442	442	402

Notes: The table displays an OLS regression with the number of rounds participants passed as the dependent variable. Results are displayed first regressing the number of rounds passed on the treatment and then adding controls. The last model is a conditional model on participants having passed round 1.
Standard errors are displayed in parentheses. *** p<0.01, ** p<0.05, * p<0.1

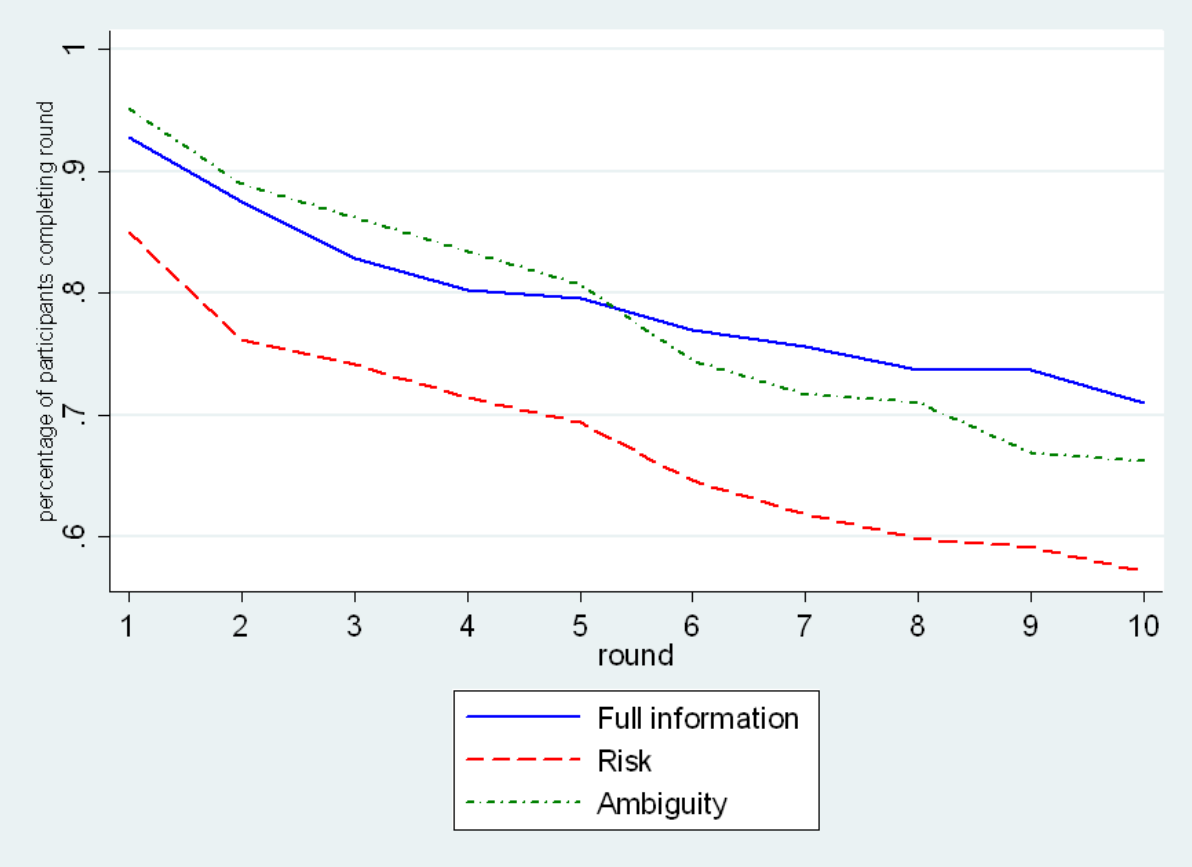
The results of an OLS regression where the dependent variable is the number of rounds completed by participants can be seen in Table 1.2[2]. These results are in line with the t-tests conducted previously, showing that participants in the risk treatment exerted the lowest level of effort. Post estimation tests confirm that participants in the risk treatment completed significantly fewer rounds than participants in the full information treatment

[2] We choose to use a simple OLS model due to how straight forward it is to interpret results and because it allows us to effectively answer our research questions. We considered using a hazard or survival model and conditional models that would allows us to more precisely see behaviour in each individual round as well as how revealing the state of the world affects effort. However, we chose to forgo these models as they proved to be complicated to implement and made interpretation of results less straightforward. Furthermore, they addressed more details and points that our main research questions were not concerned with and therefore introduced unnecessary complexity.

(p=0.0066). Participants in the risk treatment also completed significantly fewer rounds than participants in the ambiguity treatment (p=0.0129). There is no significant difference in the number of rounds completed between the full information and ambiguity treatments (p=0.8409).

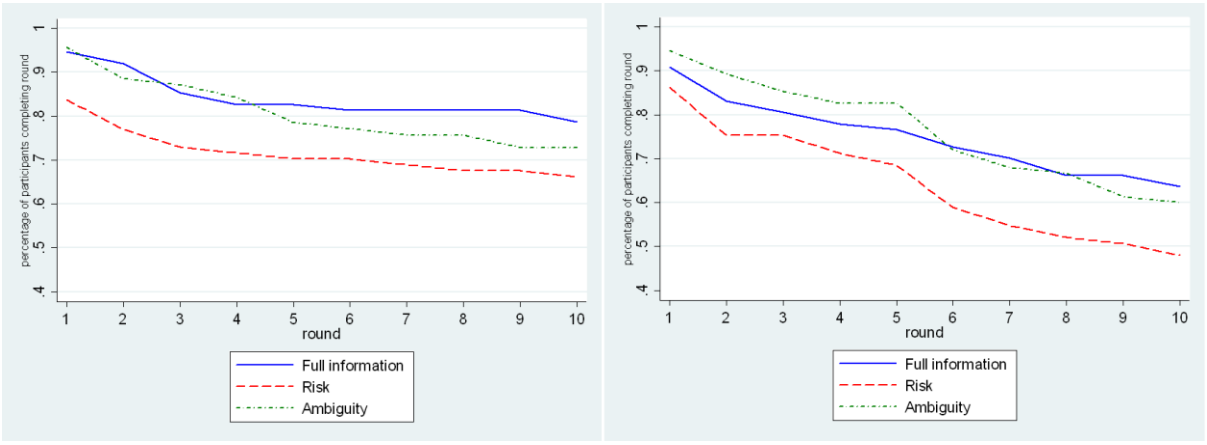
In order to determine what is causing the difference in effort between the treatments, we examine Figures 1.4 which shows the average number of participants who completed each round split by treatment. We note that the slopes of each of the treatment appear to be quite similar, with the main difference being caused by an immediate drop off in round 1 completion by participants in the risk treatment. Note that the treatment is implemented before the first round of the task. We can verify that this is true regardless of the outcome of the treatment state of the world that participants find themselves in (whether they have longer or rounds or not) by examining figure 1.5 which shows a consistent trend.

Figure 1.4 – Percentage number of participants that completed each round by treatment



There is noticeable drop-off after round 5 in the ambiguity treatment that is also present in the risk treatment which would correspond to participants learning whether they have longer rounds in section 2. In Figure 1.5 this drop-off is only present in the high outcome, confirming our logic that this drop-off can be expected from those participants that find they have longer rounds.

Figure 1.5 – Percentage of participants completing each round by treatment and split by treatment outcome



Using the same OLS model but conditioning the regression on participants having passed round 1, we can see that the significant effect between the treatments disappears (Table 1.2 conditional model). This supports our conclusion that the difference in treatments is primarily driven by participants in the risk treatments dropping in the first round, with effort remaining similar between all treatments for the remainder of the rounds.

Heterogenous treatment effects based on perseverance

A robust collection of literature draws a link between non-cognitive skills as predictors of success in different fields alongside economic factors (Kautz et al., 2014; Becker et al., 2012; Borghans et al., 2008; Barrick and Maunt, 1991) with evidence showing that grit and perseverance correlate with individual's success in education and industry (Eskreis-Winkler et al., 2014, Duckworth et al., 2007), exemplifying the importance of perseverance as a non-

cognitive skill. For example, Salisu et al., (2020) find that perseverance of effort strongly correlated to aspects of career success in entrepreneurial careers.

Furthermore, the growing interest in and consensus on the importance of perseverance in success is exhibited through a parallel literature strand which explores different strategies for improving people's grit and perseverance in order to foster future success (Incekara-Hafalir et al., 2022; Bettinger et al., 2018), such as interventions within young children that make them more perseverant and improve success in their schooling (Alan and Ertac, 2019).

Related to perseverance and grit is resilience, which is an individual's ability to bounce back and has seen equal attention in the area of positive psychology (Vella & Pai, 2019; Fletcher and Sarkar, 2013; Herrman et al., 2011). This literature focuses on how individuals are able to cope with the stresses and adverse events of life and the different factors that allow them to move past them. Factors that contribute to an individual's resilience are numerous and include not just psychological factors but have also genetic and biological factors that have been explored. A recent study by Chen et al. (2022) has found that grit, which indicates perseverance, predicted student outcomes during Covid-19.

Given the psychology literature on perseverance, grit and resilience, there is reason to believe that some people will react more positively to both risk and ambiguity, being able to put in effort despite the shocks to their productivity. We therefore chose to measure perseverance to use an additional control in our studies to determine whether this proves to be a psychological factor that helps determine behaviour. To this end we use the Grit S measure in order to obtain a score for an individual's perseverance.

For our measure of perseverance, we use a continuous measure from 1-5, 5 indicating that an individual exhibits high perseverance. The median perseverance for subjects was

3.375 and roughly normally distributed, with no significant differences in distributions between treatments and treatment state outcomes. Figure 1.6 shows the distribution of the

Table 1.3 – List of questions used to elicit perseverance measure

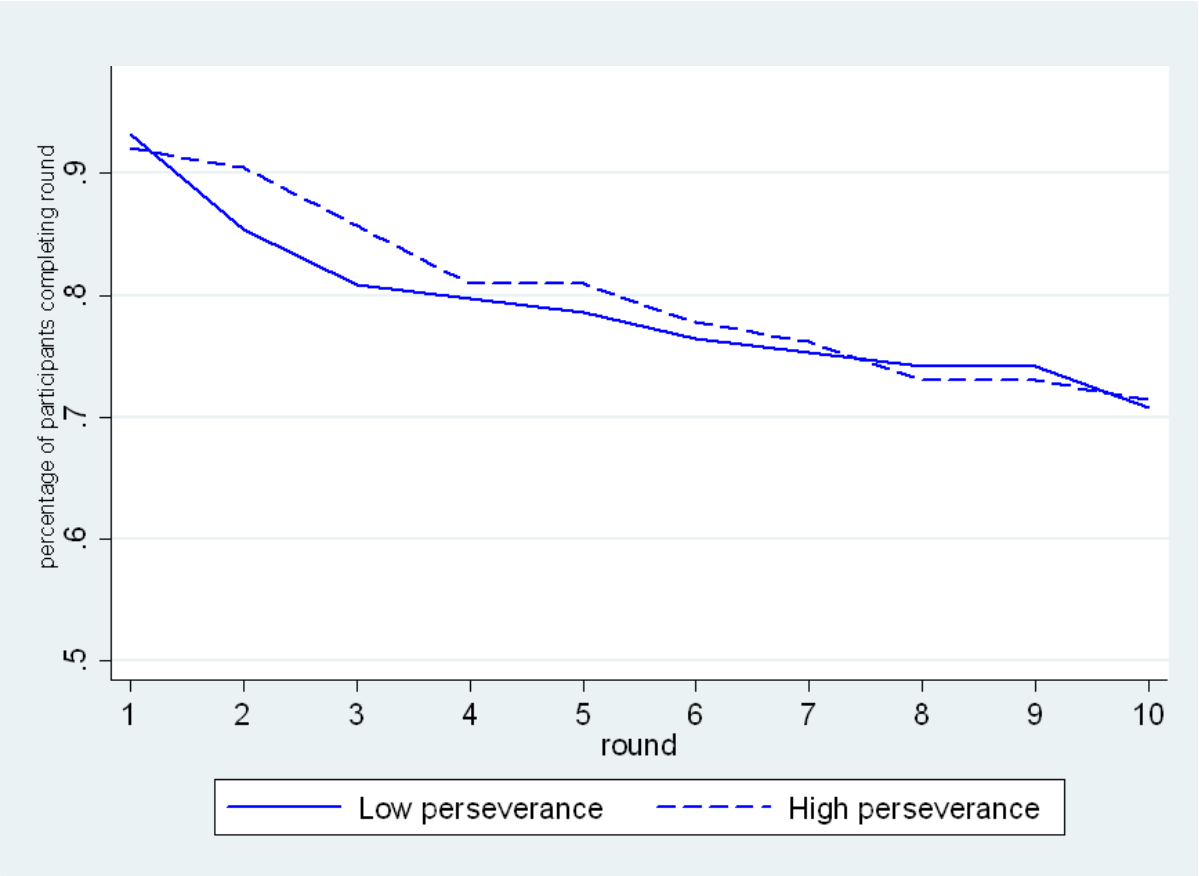
1. I often set a goal but choose to pursue a different one.
2. New ideas and project often distract me from previous ones.
3. I have been obsessed with a certain idea or project for a short time but later lost interest.
4. I have difficulty maintaining my focus on projects that take more than a few months to complete.
5. I finish whatever I begin.
6. Setbacks don't discourage me.
7. I am diligent.
8. I am a hard worker.

measure by treatment. Using a Kruskal-Wallis test we find that there is no significant difference between the distributions in each treatment (p=0.4624).

Table 1.3 shows the list of eight questions used for our perseverance measure[3]. Participants answered these questions on a 5-point Likert scale ranging in statements from "not like me at all" to "very much like me" and the middle option indicating "somewhat like me". The first 4 questions are framed in a negative context and therefore have their coding reversed with respect to the second two questions.

[3] The perseverance measure is constructed using an average of the response values. Half the of the questions are framed in the negative and are coded accordingly with their values being reversed.

Figure 1.6 – Participants completing rounds in the Full Information treatment by perseverance



Figures 1.6, 1.6 and 1.8 show graphs of the average number of participants that completed each round for each treatment split by participants that have high and low perseverance. The full information and ambiguity treatments do not appear to have any significant differences between perseverance levels. The risk treatment, on the other hand, appears to show that participants with a high perseverance level completed more rounds.

Figure 1.7– Participants completing rounds in the Risk treatment by perseverance

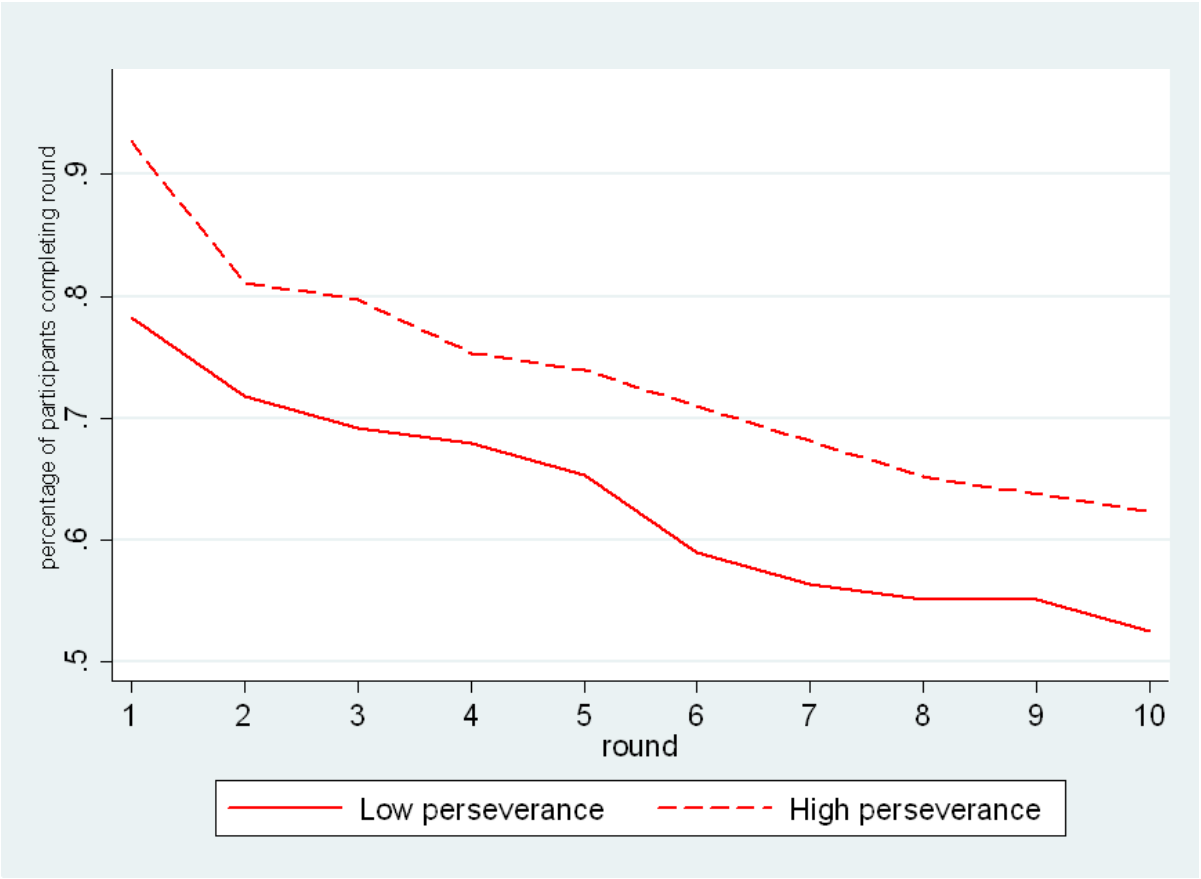
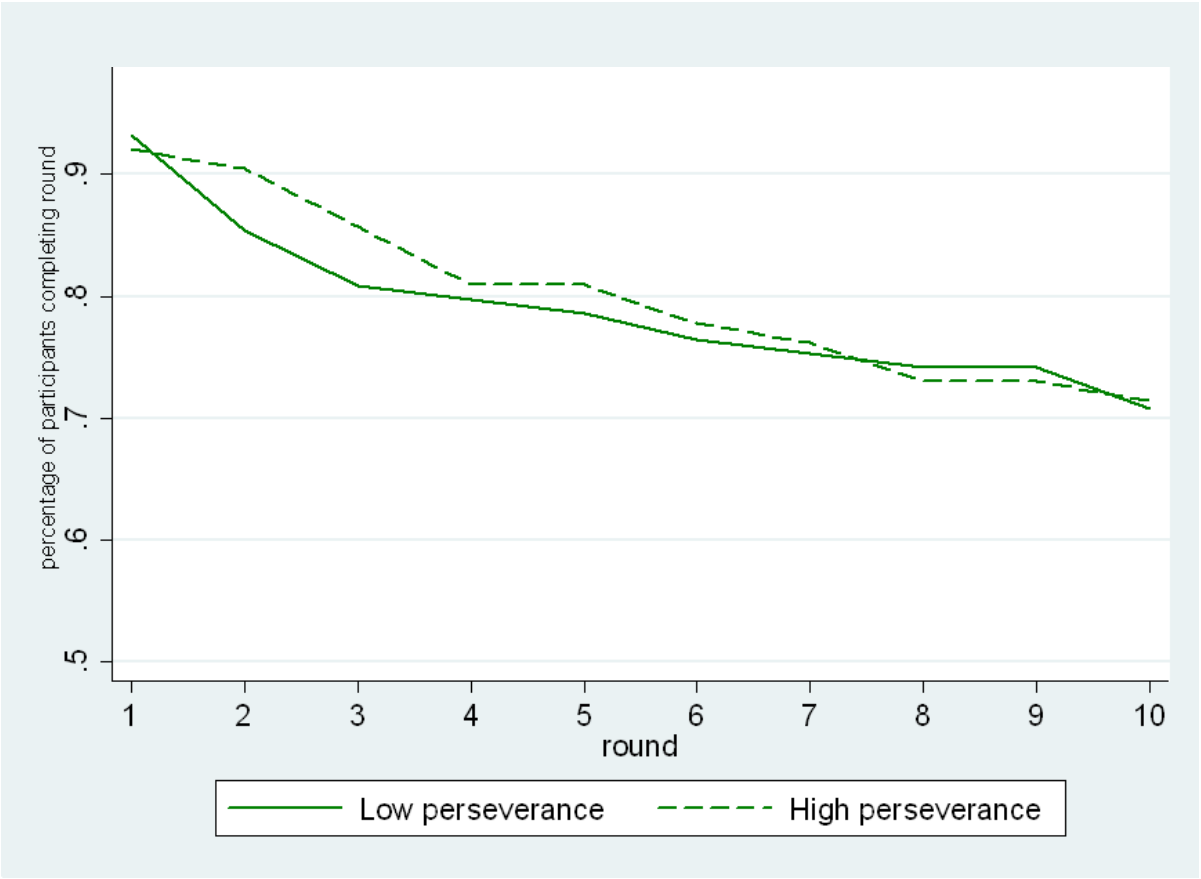


Figure 1.8 – Participants completing rounds in the Ambiguity treatment by perseverance



To test whether treatment effectiveness is affected by the level of perseverance, we split the perseverance measure into a high perseverance and low perseverance group using the median perseverance score as the delimiter. We then conduct t-tests within each treatment testing whether there is a difference between the average number of rounds completed by individuals who are classified as high perseverance and those with low perseverance. Because Figure seems to indicate that in the risk treatment there is a difference in round 1 completion between individuals of high and low perseverance, we conduct a t-test on the risk treatment testing whether there is a difference between round 1 completion for participants with high and low perseverance.

Table 1.4 – OLS regression of total rounds passed on treatment and perseverance score

	model 1	model 2	model 3
Risk	-1.152***	-1.580***	-1.621***
	(0.431)	(0.578)	(0.583)
Ambiguity	-0.0925	0.176	0.141
	(0.433)	(0.576)	(0.581)
High perseverance		0.128	0.0894
		(0.614)	(0.624)
Risk X High perseverace		0.897	0.933
		(0.869)	(0.875)
Ambiguity X High perseverance		-0.601	-0.527
		(0.873)	(0.880)
Constant	7.941***	7.888***	8.054***
	(0.302)	(0.395)	(0.835)
Risk Measure			-0.00798
			(0.0349)
Female			-0.120
			(0.361)
Age			0.000399
			(0.0135)
Observations	444	444	442

Notes: The table displays an OLS regression with the number of rounds participants passed as the dependent variable. Results are displayed first regressing the number of rounds passed on the treatment then interacting the treatment with a dummy variable for the perseverance score, then adding controls.
Standard errors are displayed in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Our results suggest that there is no significant difference between individuals of differing perseverance levels within the treatments (Full information p=0.73, Risk p=0.25, Ambiguity p=0.68). Therefore, an individual's level of perseverance has no impact on the effectiveness of the treatment on average. However, there is a significant difference in the risk treatment for round 1 completion (p=0.033). An OLS regression interacting the treatment with individual's perseverance scores shown in Table 1.4. Post estimation t-test show that there are no significant differences in effort provision between individuals of differing perseverance scores within each treatment.

1.6 Discussion

Our results are counter to what we anticipated. First it is interesting to note that the full information treatment did not have the highest effort provision. Instead, the highest effort provision was shared between the full information treatment and the ambiguity treatment. This indicates that under ambiguity, people allocate effort in a similar way as they would if they had complete information. It may be that, in the absence of any information about probabilities, people will disregard any notion of chance and act as though they have complete knowledge about outcomes.

Next and most surprisingly, we find that risk was found to have the lowest effort provision of the treatments, being below ambiguity. This is counter to what we know regarding how people normally behave, as they tend to exhibit ambiguity aversion. In particular, we find that the low effort provision under risk comes from an initial drop off in the completion of the first round. Such behaviour indicates that the probabilities of 50/50 are not favourable to participants, and they do not deem the bonus sufficient for the risk of greater effort.

Given the way that participants in the ambiguity treatment behave as though they have full information and participants in the risk treatment drop off early, we speculate that under ambiguity participants are more optimistic about the probabilities. Since a 50/50 chance of having longer rounds appears to be too great for people to want to complete all rounds, it is reasonable to suggest that under ambiguity participants assume a probability for having 1-minute rounds that is greater than 50%.

We additionally find it surprising that the perseverance measure did not prove to have an effect on the effectiveness of treatments on average. It may be that perseverance on its own is not sufficient enough to have a large effect on the behaviour of participants in our environment. The effort costs and monetary incentives effectively crowding out any effect perseverance would have. At the same time, perseverance did have a significant impact on participants in the risk treatment. Another possibility is that the perseverance measure we used was not a sufficiently accurate measure, although it has been proven as an effective measure in the psychology literature in prior studies.

There may be a consideration about the external validity of our experimental design and the results given the intentional lack of intrinsic motivation within the task. While including a task that has little intrinsic motivation to participants is an intentional design decision in order to better control for any such effects, in can be argued that people's decisions may in fact be different in the real world where the task they engage in will have intrinsic motivation.

Firstly, it may not always be the case that the task that a person will engage in will necessarily have intrinsic motivation, as we can imagine people doing low skilled labour where the main motivation is monetary pay (as is mirrored in our own design). Furthermore, in the scenario where the task does have intrinsic motivation, the effect should be a mediating

effect that will either make working on the task easier or more difficult in the absence of such motivation. We included the Intrinsic Motivation Index for this reason in our survey measures to control for any such effects, and do in fact find that there is a significant increase in effort when intrinsic motivation is disproportionately high.

1.7 Conclusion

People frequently contend with ambiguity. Individuals allocate their effort on tasks where setbacks would make it more costly to work. These setbacks can change their effort provision. In the face of such shocks, whether the probability of the shock occurring is known or not may be an important factor in how effort will be allocated. It is therefore important to understand how risk (known probabilities) and ambiguity (unknown probabilities) affect how people allocate effort. Furthermore, perseverance has been found to be a non-cognitive skill that predicts success and higher achievement. We would expect that individuals who are more perseverant are more likely to allocate effort in the face of potential setbacks.

Using an online experiment we look at how participants behave in scenarios where a potential increase of effort has either an explicit probability or an ambiguous chance of occurring. We find that contrary to our hypothesis, subjects who did not know the exact probability of the shock occurring complete more rounds of the task compared to individuals who knew the exact probability. Further, under ambiguous probabilities, participants behaved similarly to those who had full information.

This effect is driven primarily by round 1 completion of the effort-task. Subjects in the risk treatment are found to have the lowest round 1 completion rates. Following initial entry subjects in both the risk and ambiguity treatments behave similarly to each other. There are no significant differences in their behaviour when it is revealed that they have longer or shorter rounds in the second half.

We do not find that a participant's level of perseverance as measured by a survey has a significant impact on their entry or completion of the task. We speculate that our results may differ from the existing literature on ambiguity aversion due to differences in domain, as we focus on the real effort domain.

Further research into effort choices under risky and ambiguous conditions may shed more light on the mechanisms of how individuals choose to allocate their effort in the face of possible setbacks.

Chapter 2

Effort Under Risky and Ambiguous Positive Shocks

2.1 Introduction

Any kind of productive work requires that an individual exert effort in order to be successful. However, exerting effort can be an unattractive prospect due to opportunity costs (Otto and Daw, 2019; Erkal et al., 2018; Georg et al., 2019). In some cases, opportunity costs may decrease, with positive events occurring that decrease the amount of effort needed to complete a task. If people are aware of such events, the level of information that they have about how likely it is to occur may affect how much effort they will exert in the first place.

When dealing with uncertainties, people's expectations can influence how they will exert effort; studies show that when people expect greater payoffs they exert more effort (Abeler et al., 2011). Uncertain environments have been simulated primarily in principal agent problems where agents have limited information about shocks that interrupt their performance (Rubing and Sheremeta, 2015, Budde and Kräkel, 2011). A gap is present in the literature looking into how individuals choose to allocate effort when uncertainties around events that can decrease the time cost of effort are present. Additionally, the literature seldom compares outcomes between risk and ambiguity in the effort domain. We therefore study whether there are differences in how people exert effort under risky and ambiguous positive shocks in hopes to contribute to the literature on effort provision.

Individual decision-making on effort provision may be influenced by the likelihood of events occurring that will affect the time cost of effort. Such shocks, however, may not always be negative. In some instances, individuals can experience shocks that reduce the time cost of effort, such as when a friend offers to help in building furniture after a move. While an individual may be aware that the friend could help if they can, in some instances they may have more precise information about the probability of the friend helping.

Therefore, the level of information that the individual has about the event occurring could influence how they behave and choose to exert effort. In some instances, people may have an approximate probability in mind, expecting that the event can occur with a 50% probability for example. In other instances, the person may only be aware that the event can occur but have no additional information that would indicate an approximate probability. In this case, the individual would naturally form beliefs about this probability that would influence their behaviour.

To answer our questions, we conduct an online experiment where participants engage in a real-effort task. This task is comprised of ten rounds split into two sections of five rounds each. For all participants the first 5 rounds are 2-minutes long each. The second 5 rounds can either remain 2-minutes long or can be 40-seconds long. There are two treatments, risk and ambiguity, which vary the level of information participants receive about the probability of this shock occurring. In the risk treatment, participants are told there is a 50% chance of the shock occurring. In the ambiguity treatment, participants are told that there is some unknown probability of the shock occurring. Our outcome variable is how many rounds participants complete during the task.

We find that there are no significant differences in the effort provision of participants based on the level of information that they have of a positive event occurring. On average, participants in the ambiguity treatment form beliefs that indicate they think the probability of the positive event is 50%. The largest impact is caused by whether the positive event occurs or not, participants in both treatments are more likely to complete fewer rounds if the positive event does not occur.

2.2 Literature review

The primary literary that we draw on for this study deal with effort provision. In general researchers have found that people's effort provision can be dependent on their perception and expectations of outcomes and success (Abeler et al., 2011; Gill & Prowse, 2012; Bushong & Gagnon-Bartsch 2023; Burke et al., 2023). Findings suggest that people tend to work on tasks longer when their expectations for payment or success are greater.

With evidence showing that monetary payoffs are a powerful incentive for effort (DellaVigna & Pope, 2018; Erkal et al., 2018), expectations of payment and success play a crucial role in people's decision making as to how to exert effort. People may find it more difficult to form expectations in the absence of probabilistic information, however. Instead, individuals will need to form beliefs about the probabilities of the potential outcomes and form expectations using these beliefs.

As such, subjective beliefs may play a crucial role in determining how people will behave in an uncertain environment where there is some expectation of an shock occurring. Literature on subjective belief updating offers a few insights. Evidence suggests that in some cases individuals update their beliefs in an asymmetric manner when beliefs adhere to a few different criteria, such as being ego-relevant or financially relevant (Drobner & Goerg, 2024; Drobner, 2022; Coutts et al., 2023). Although these studies show how biased beliefs can be formed and updated in uncertain environments, this updating occurs to preserve an individual's ego or due to hopeful expectations about financial outcomes.

Our question deals with a different environment where beliefs are formed about an external event that is out of the control of the individual. Furthermore, the domain isn't financial in the sense of lottery outcomes, as subjective beliefs are normally studied in an uncertain environment. Instead, we look at the domain of effort, where the event influences the cost of effort to the individual rather than the payment outcomes itself. In this way, it is

possible people will form optimistic beliefs that will overshadow the ambiguity, in this way maximising their utility (Brunnermeier & Parker, 2005).

We also draw on the literature dealing with risk and ambiguity. The majority of this literature addresses the question in the specific context and environment of lotteries, where people make choices on their preferred lotteries based on different probabilities of the risky lotteries as opposed to lotteries where the probabilities are ambiguous. An important finding stemming from the research in this area is that individuals tend to exhibit what is termed 'ambiguity aversion'.

This means that in general, people tend to prefer lotteries where the probabilities of outcomes are known to them, rather than unknown (Machina and Siniscalchi, 2014; Weber and Tan, 2012). One interpretation of this preference is that under ambiguity people will form pessimistic beliefs, placing greater weight on the undesired outcome to occur. More specifically, some findings suggest that people tend to be ambiguity averse in the domain of gains and indifferent between in the domain of losses (Cohen et al., 1987).

Our study will add to this literature by showing how people behave when presented with risk and ambiguity in an environment that requires effort on the part of the participant. Furthermore, the payoffs of the individual is entirely dependent on their effort and willingness to exert the appropriate amount of effort to achieve the end goal.

2.3 Experimental design

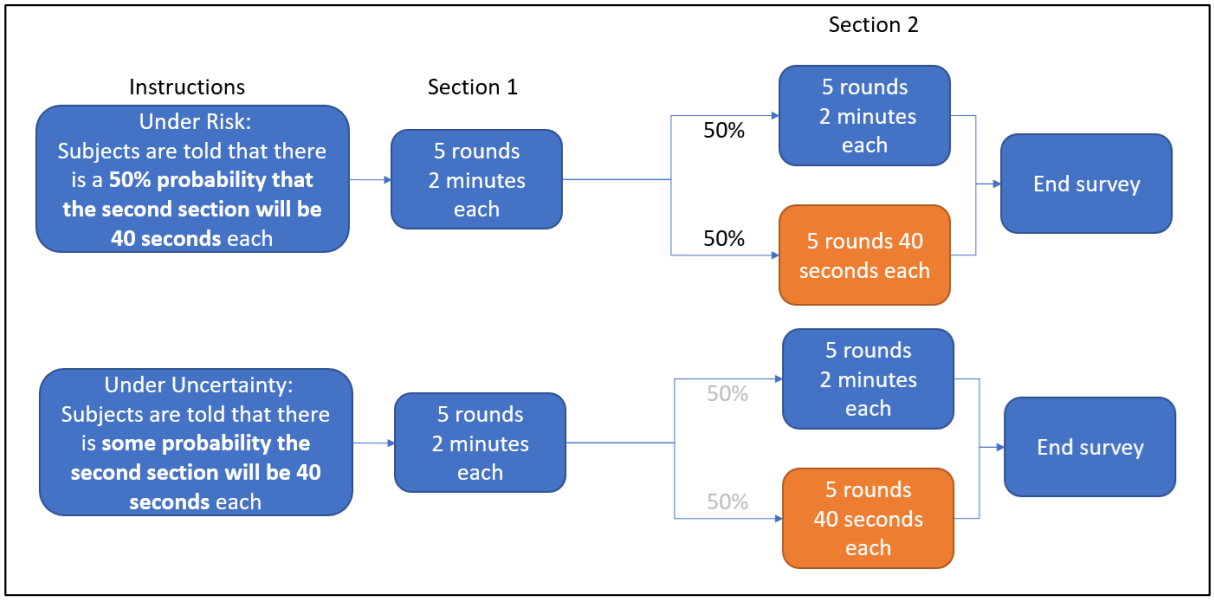
Treatments

The overall structure of the experiment is a between subjects design that includes ten rounds of a real-effort task that are split into two sections of five rounds each (Figure 2.1). Sections differ in the length of time that rounds take to complete. The length of rounds in section 1 is the same for all participants. Section 2 can have rounds that are the same length

as in section 1 or that are shorter. Our main outcome measure is the number of rounds that subjects complete (0-10), acting as our measure of effort.

There are two treatments: risk and ambiguity. The two treatments differ in the information that subjects receive about the second section. In the risk treatment, subjects are

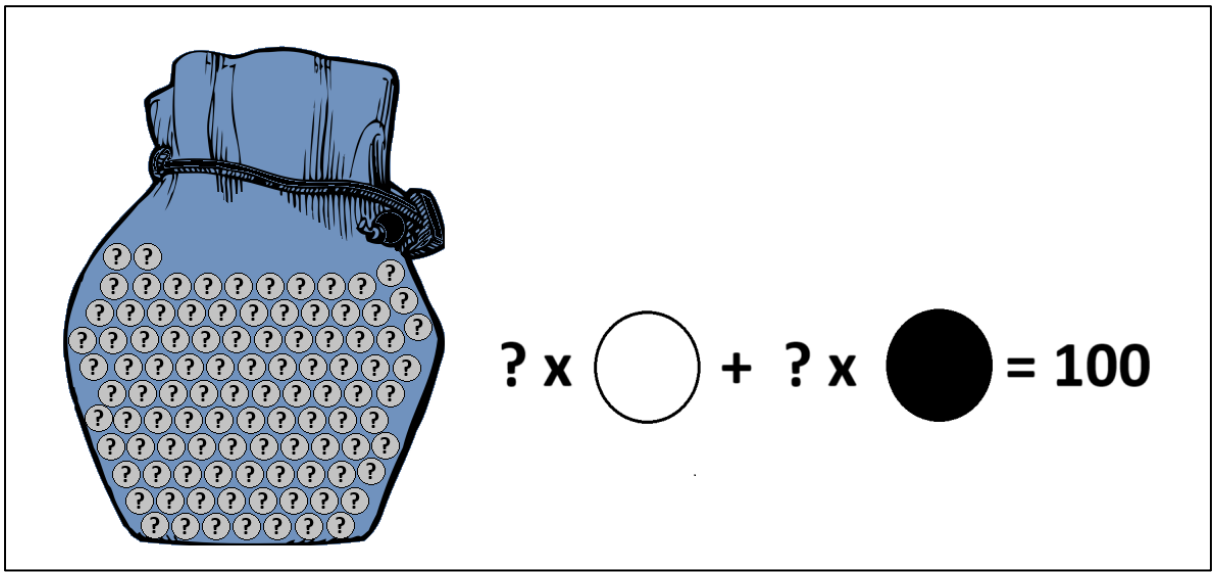
Figure 2.1 – Overall structure of the experiment



told that the rounds have a 50% probability of being either 2-minutes or 40-seconds long. In the ambiguity treatment, subjects are only told that there is some unspecified probability of each event occurring. These probabilities are presented to subjects in the form of a hypothetical scenario where they are drawing marbles from a bag (Figure 2.2).

We choose to not include a control treatment as we did in the first experiment for two reasons. First, in this chapter we were more interested in finding precise effect differences between the risk and ambiguity treatments and therefore wanted to create greater power between the two treatments. Second, given the structure of the experiment and the way in which information is provided about the length of rounds, the control treatment would very closely match the previous control treatment as the total time spent in the control treatment between experiments would be very close to each other, the only difference being whether the loner rounds occur first or second.

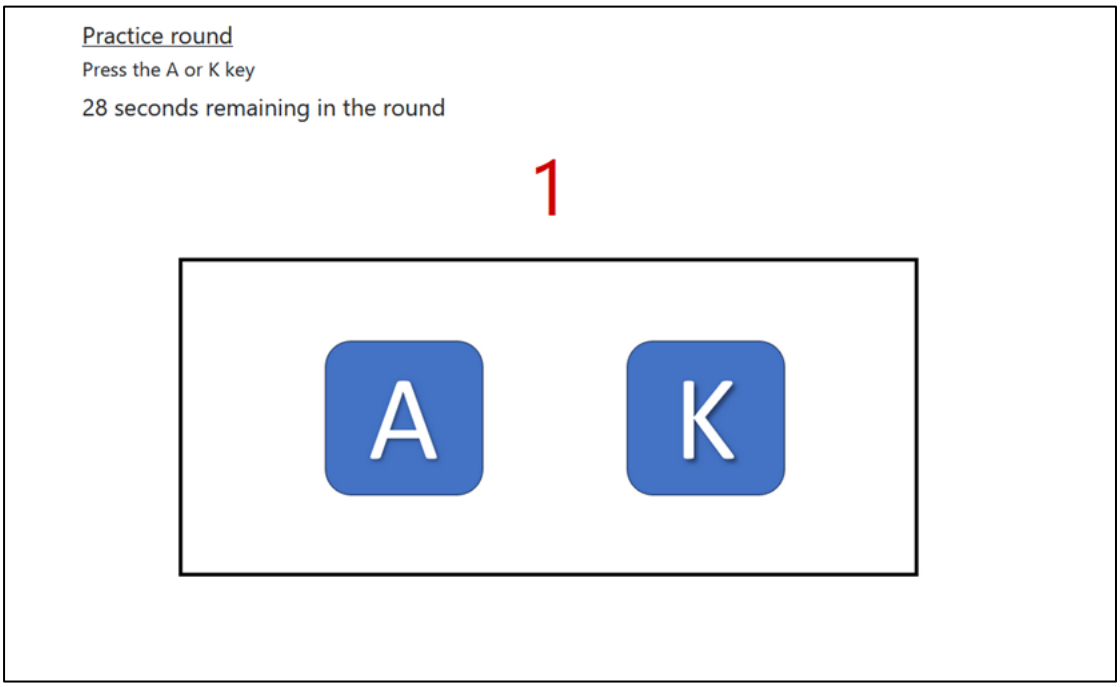
Figure 2.2 – Example image of instructions for uncertainty treatment



The task

The task itself is a real-effort task wherein participants alternate pressing the 'A' and 'K' keys on their keyboard, with visual feedback provided for clarity (Figure 2.3). The same key cannot be pressed twice in a row, and participants have a total of 3 seconds to press the next

Figure 2.3 – Example of real-effort task screen



key before they are timed out and the round is considered failed. Therefore, subjects must exert consistent effort by alternating between the two keys for the duration of the round.

The experiment was coded using the o-Tree software and participants were recruited on Prolific. It took participants about 30 minutes on average to complete the experiment, with large variations in the completion time due to the nature of the treatments and participant's ability to stop skip to the end surveys at any time. Throughout the experiment we implemented intermittent attention checks to ensure that participants were reading instructions and not just clicking through the screens. Additionally, we implemented two different comprehension tests that made sure participants understood the instructions for the task and the general round and treatment structure respectively. The main outcome measure is the number of rounds that participants complete (0-10), acting as our effort measure. Participants are incentivised to complete all 10 rounds with a bonus payment that is conditional on full completion.

Surveys

The end portion of the experiment features several different survey measures that we use as controls in our analysis. These surveys include the IMI (Intrinsic Motivation Index), a measure of risk preferences, a measure for perseverance (Grit S measure), a measure of ambiguity preferences and certain demographic questions that are not provided by prolific. These surveys are kept short and take an average of 5-10 minutes to complete. All of these measures are unincentivized.

The IMI survey is comprised of 18 Likert scale questions that measure how motivating participants found this task from Ryan (1982). This allows us to control for participants whose enjoyment of the task potentially outweighed any costs of engaging in it. The perseverance

measure is a similar Likert scale questionnaire that measures a person's general level of 'grit' or perseverance that was developed by Duckworth and Quinn (2009).

Risk preferences are measured using the risk elicitation survey method from the preference survey module developed by Falk et al. (2016). Finally the ambiguity preferences measure is derived using a simple task adapted from Dimmock et al. (2016), where subjects taste their preferences between drawing from a bag that where the number of black and white marbles is equal and known, and a bag where the number of coloured marbles is unknown.

2.5 Results

Summary statistics

We collected data on 394 subjects through prolific, Table 2.1 shows a balance table with treatment differences between variables. The risk treatment had 198 participants, and the ambiguity treatment had 196. We used a gender balanced pool with 197 participants reporting as Female, 194 Male, and 3 participants who reported as being non-binary. Age is a categorical variable with values between 1 and 7 corresponding to relevant age groups. On average participants in both treatments completed about 6 out of 10 rounds with a total average of about 2000 key presses.

Table 2.1 – Balance table for relevant variables

	(1) Risk treatment	(2) Ambiguity treatment	(3) Difference (1)-(2)
age	4.19	4.18	0.01
	(1.25)	(1.22)	(0.12)
gender	1.51	1.51	-0.01
	(0.51)	(0.52)	(0.05)
total key presses	1906.96	2143.39	-236.42
	(1995.36)	(2101.85)	(206.51)
risk_measure	9.82	9.97	-0.15
	(5.72)	(6.40)	(0.61)
ambiguity aversion score	3.75	3.67	0.08
	(1.12)	(1.10)	(0.11)
intrinsic	2.10	2.33	-0.24**
	(0.96)	(1.01)	(0.10)
N	198	196	394

Our ambiguity preferences measure, which was a categorical variable from 1-5 indicating the person's preferences for drawing from a particular urn shows a mean of 3.7 with a median value of 4 which corresponds to the answer "Slight preference to draw from urn B" (the urn with known distribution of marbles), suggesting that on average participants were somewhere between indifference and slight ambiguity aversion. The mean value for age was 4, which corresponds to the age group 35-44. No significant differences between treatments are found for any of the variables reported.

Our main variable of interest is the number of rounds completed by participants. Participants in the risk treatment completed an average of 5.6 rounds. In the ambiguity treatment participants completed an average of 5.9 rounds. A t-test shows no significant

Table 2.2 – OLS regression of total rounds completed by participants on treatment and controls

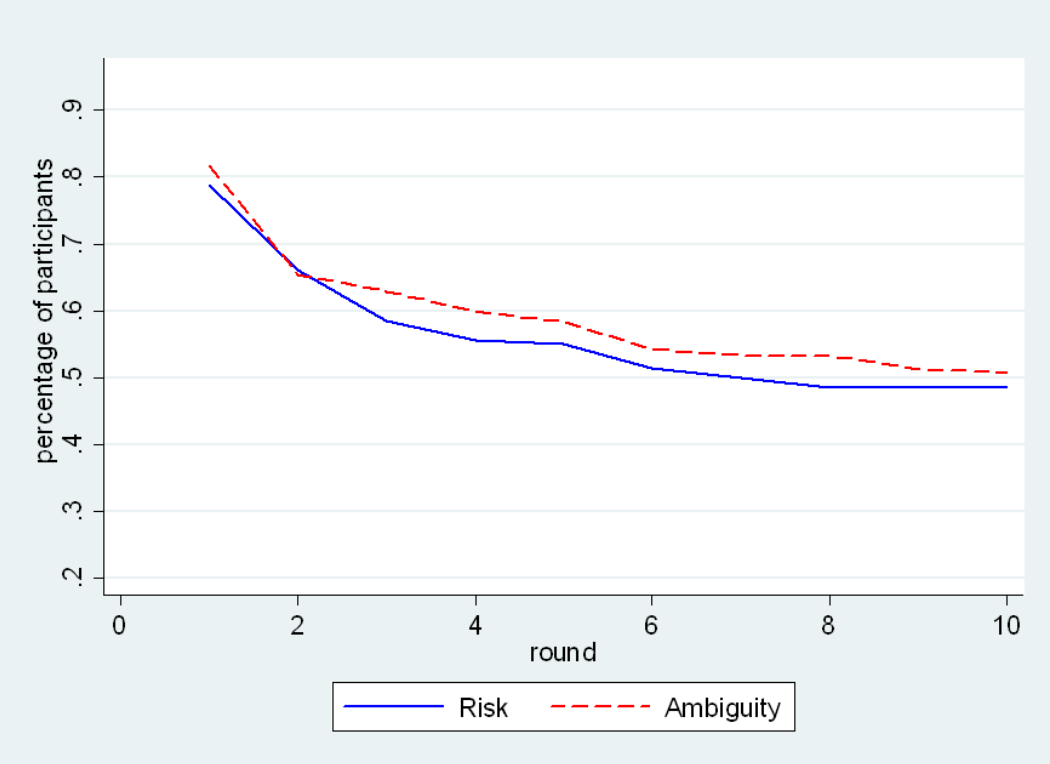
	model 1	model 2	model 3	model 4	m5
Ambiguity	0.328	0.317	0.335	0.336	0.0827
	(0.449)	(0.450)	(0.448)	(0.448)	(0.440)
Constant	5.611***	6.115***	5.570***	6.008***	3.366***
	(0.317)	(0.825)	(0.874)	(1.152)	(1.250)
Ambiguity aversion score		-0.134	-0.105	-0.0984	-0.0527
		(0.203)	(0.203)	(0.203)	(0.198)
Female			0.901**	0.880*	0.641
			(0.451)	(0.453)	(0.444)
Non-binary			-3.110	-3.320	-2.689
			(2.587)	(2.614)	(2.547)
Age				-0.108	-0.0270
				(0.184)	(0.180)
Intrinsic motivation index					1.073***
					(0.225)
Observations	394	394	394	394	394

Notes: The displays an OLS regression with the number of rounds participants passed as the dependent variable. Results are displayed first regressing the number of rounds passed on the treatment and then adding controls.
Standard errors are displayed in parentheses. *** p<0.01, ** p<0.05, * p<0.1

differences in the number of rounds completed between the two treatments (p=0.47). Using a Kruskal-Wallis test, we find no significant differences between the two distributions of total number of rounds completed between treatments(p=0.5463).

We further use an OLS regression to model the effort provision of participants. Our dependent variable is the total number of rounds completed by participants, with a dummy treatment variables and controls for individual's ambiguity aversion score[4], gender and age (Table 2.2). We find there is no significant difference between the treatments, with some differences present between participants that reported being male and female. Post estimation tests confirm that there is no difference in effort between treatments (p=0.4540).

Figure 2.4 – Percentage of participants completing each round by treatment



We can further investigate any potential differences in effort provision between the treatments by looking at individual round completion by treatment. Looking at Figure 2.4 we

[4] The ambiguity aversion score is categorised using a scale of 1-5 based on the responses provided by participants in the elicitation task. A score of 1 indicates that participants are strongly ambiguity seeking, a score of 3 indicates that participants are indifferent between ambiguous and risky choices, and 5 indicates that participants are strongly ambiguity averse.

can see that the slopes follow each other closely, with individuals in both treatments having similar round completion. Therefore, we can conclude that there is no evidence for differences in exerted effort between participants in the risk and ambiguity treatment in the positive domain.

Heterogeneous treatment effect analysis

In the survey section of experiment, we elicited participants ambiguity attitudes. This was done through a task which presented participants with hypothetical scenario where they are asked to choose between drawing a marble from one of two urns. One urn is stated to have 50 black and 50 white balls. The other urn has an unknown amount of each colour totalling 100 marbles. Participants are asked on a 5-point Likert scale which urn they would prefer to draw from if a colour of their choice would yield them a hypothetical reward (Figure 2.5).

A score of 5 indicates that a participant is very ambiguity averse, a score of 3 indicates indifference, and a score of 1 indicates that the participant is very ambiguity seeking. Using a Kolmogorov-Smirnov test we find that there is no significant difference in the distribution of scores between the two treatments (p=0.81).Next, we code a new variable that combines the ambiguity scores into three categories: ambiguity seeking, neutral and ambiguity averse. Using this new variable, we investigate whether there are any differences in effort provision between participants of different ambiguity preferences within each treatment.

Figure 2.5 appears to show that participants who are ambiguity averse exert less effort in the risk treatment that participants whose scores indicate indifference or ambiguity seeking attitudes. However, t-tests on the average number of rounds completed between ambiguity averse and neutral, or ambiguity seeking individuals indicate that this difference is not statistically significant (p=0.33 & p=0.21 respectively). Figure 2.6 shows the opposite

relationship in that ambiguity averse individuals exert greater effort than ambiguity seeking or neutral individuals. Once again, these differences are shown to not be statistically significant using t-tests (p=0.88 & p=0.92).

The results of an OLS regression that interacts the treatment with the ambiguity dummy variable are displayed in Table 2.3. Using post-estimation tests, we find that there is no significant differences in effort provision between individuals of different ambiguity attitudes within each treatment. We do find that there is a slightly significant difference in effort between ambiguity averse individuals between the two treatments, with participants in the ambiguity treatment exerting greater effort (p=0.0691).

Figure 2.5 – Percentage of participants completing each round in the risk treatment by ambiguity preference

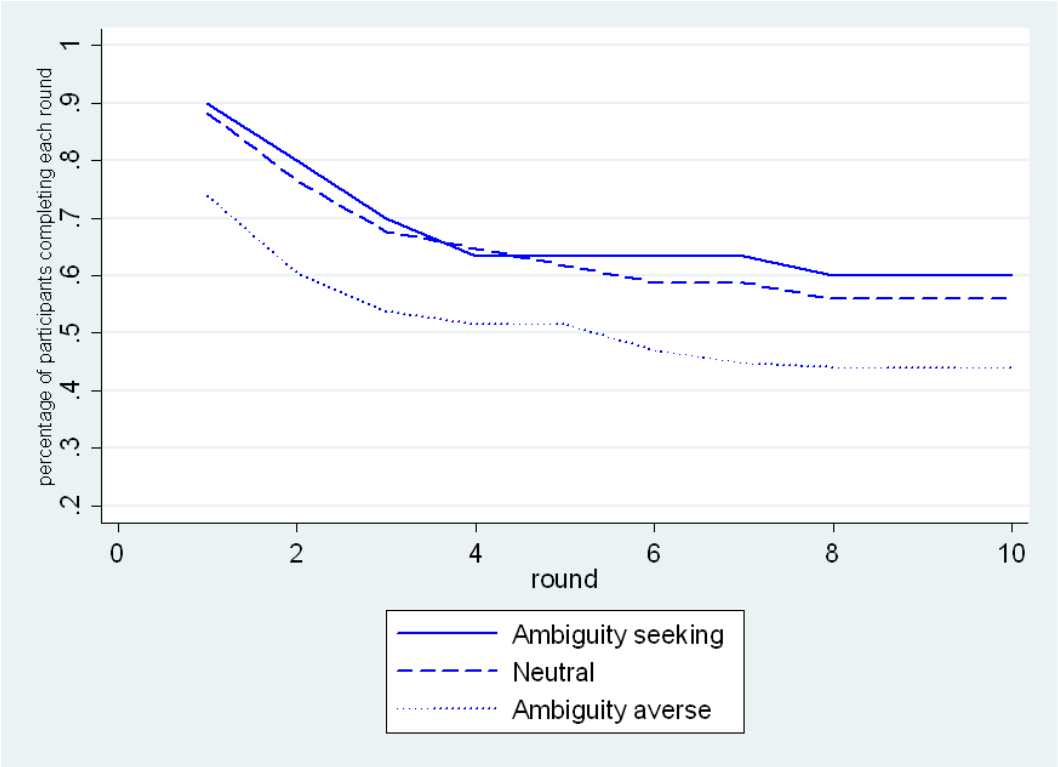


Figure 2.6 – Percentage of participants completing each round in the ambiguity treatment by ambiguity preference

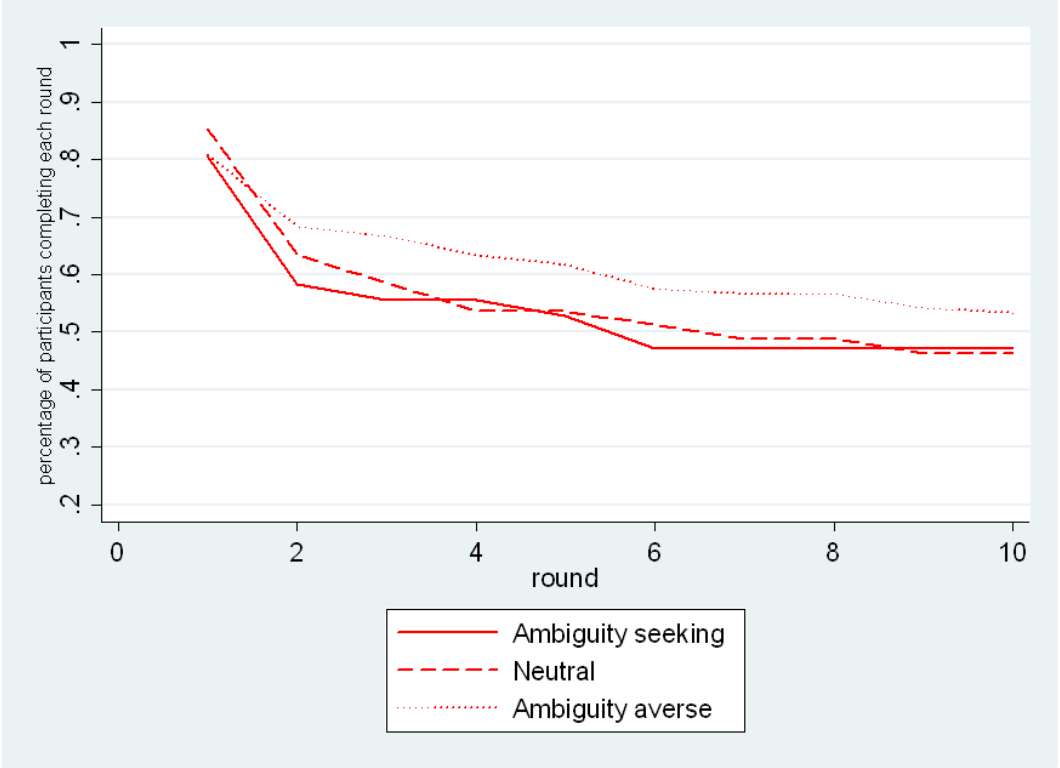


Table 2.3 – OLS regression of total rounds passed on treatment and Ambiguity score

	model 1	model 2	model 3
Uncertainty	0.328	-1.219	-1.119
	(0.449)	(1.108)	(1.107)
Ambiguity neutral		-0.292	-0.184
		(1.115)	(1.115)
Ambiguity averse		-1.584*	-1.468
		(0.899)	(0.897)
Uncertainty X Ambiguity neutral		0.339	0.251
		(1.514)	(1.515)
Uncertainty X Ambiguity averse		2.261*	2.157*
		(1.241)	(1.241)
Constant	5.611***	6.733***	6.627***
	(0.317)	(0.813)	(1.177)
Female			0.909**
			(0.452)
Non-binary			-2.840
			(2.622)
Age			-0.103
			(0.184)
Observations	394	394	394

Notes: The table displays an OLS regression with the number of rounds participants passed as the dependent variable. Results are displayed first regressing the number of rounds passed on the treatment then interacting the treatment with a dummy variable for the ambiguity score, then adding controls.
Standard errors are displayed in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Next, we explore whether there are differences in effort provision based on participant's stated beliefs about the probability of having 40-second rounds in section 2. The elicitation task was implemented for both treatments to maintain control and consistency between them, although participant's beliefs in the risk treatment should reflect the 50% probability that was disclosed to them.

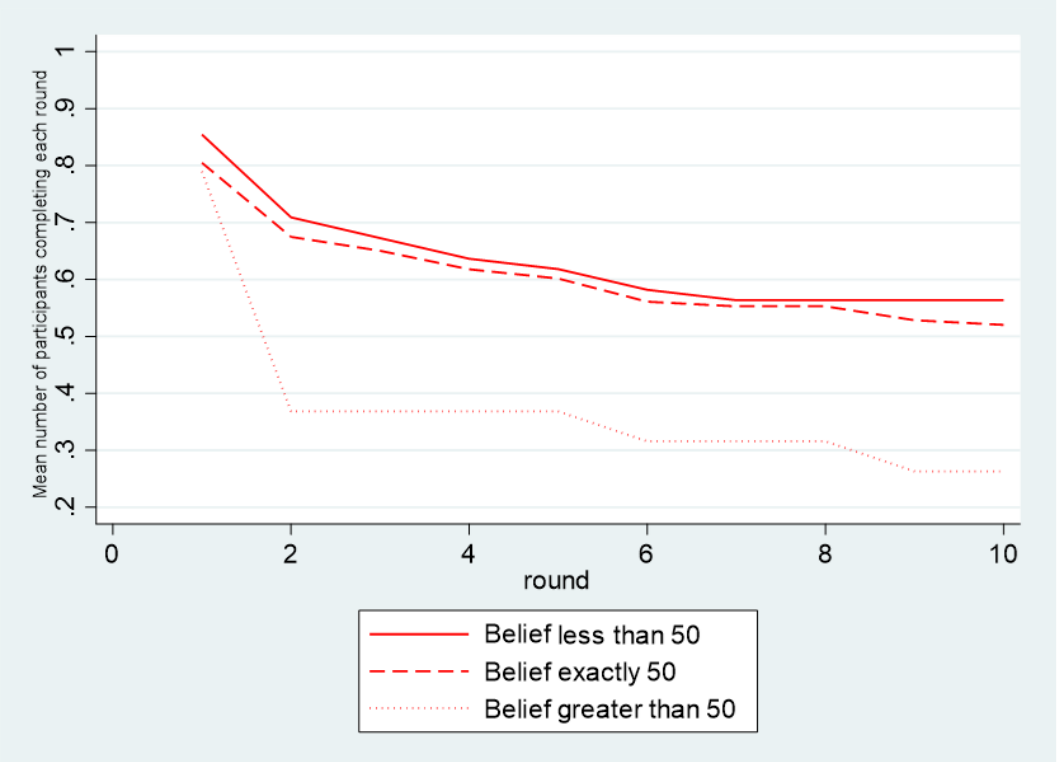
Participants are asked to indicate on a slider what they believe the probability of having 40-second rounds in the second section is. This task is unincentivized but provides us with a general idea of what participants feel the probabilities are in the ambiguity treatment.

Using the elicited beliefs, we construct a binary variable that indicated whether participants thought the probability was greater than or less than 50%.

Majority of participants indicated that their belief was 50%. As expected, there is greater variation in reported beliefs in the ambiguity treatment than in the risk treatment. A Kolmogorov-Smirnov test confirms that the two distributions are significantly different from each other (p=0.00).

Figure 2.7 shows the mean number of participants that completed each round in the ambiguity treatment split by beliefs. Unexpectedly, participants who's stated belief that section 2 would have 40-second rounds was greater than 50% have much lower effort provision than participants whose belief was 50% or lower.

Figure 2.7 – Percentage of participants completing each round in the ambiguity treatment by stated belief



A t-test on the average number of rounds completed by participants in the ambiguity treatment between participants whose belief was less than 50 and those whose belief was greater than 50 indicates that participants with a belief of greater than 50 exerted significantly

less effort (p=0.027). This is also true when comparing participants whose belief was exactly 50 and those who had a belief greater than 50 (p=0.027).

2.6 Discussion

Our results regarding our main hypothesis are counter to what we expected, in that there are no differences in effort provision between risk and ambiguity. When possible, shocks are positive it appears that people are equally willing to put in effort regardless of the level of information that they have about the shock occurring. Interestingly, the beliefs that participants formed about the probability of having shorter rounds in the second section were on average pessimistic. So even though participants had pessimistic beliefs about what the probability of the positive outcome would be, they still exerted a similar level of effort on average. Participants then, overweigh the negative outcome in an ambiguous environment, but this behaviour does not contribute to their general attitudes about ambiguity.

Our exploratory analysis yielded some interesting and contradictory results to what would be expected. In our heterogeneity analysis of participant's ambiguity attitudes we find that participants who were more ambiguity averse seemed to exert less effort in the risk treatment and more effort in the ambiguity treatment. We would have expected this relationship to be reversed given what we understand about ambiguity aversion. However, these results do not prove to be statistically significant and therefore may simply be artifacts. Greater investigation is necessary to determine whether this is a consistent result.

In our investigation of the heterogeneity in stated beliefs of having shorter rounds in the ambiguity treatment we find another surprising relationship. Counter to what logic would dictate, participants who stated having beliefs that there was a greater than 50% chance of having shorter rounds in section 2 had significantly lower effort provision than participants who said the probability was 50 percent or lower.

We would normally expect participants who have beliefs that they are more likely to have shorter rounds in section 2 to exert more effort as they believe their total time cost of effort to be lower. While this result proved to be significant, it may be an artifact caused by the low number of individuals who reported having beliefs greater than 50%. Only 29 out of 294 participants stated that their beliefs were greater than 50, with 305 stating beliefs of exactly 50 and 60 stating beliefs lower than 50.

2.7 Conclusion

People frequently have to face ambiguity and risk which can sometimes lead to positive outcomes. When faced with tasks where effort is costly, effort provision can be dependent on positive shocks occurring. Differences in how people exert effort when their knowledge about the probabilities of an event occurring could be influenced by their subjective beliefs.

Using an online experiment, we look at how subjects choose to allocate their effort in an environment where they are aware that a shock might occur. We provide subjects with different levels of information about the probability of this sock occurring, where one group knows the probability and the other just knows the shock may occur. We find that, contrary to our hypothesis, there is no difference in the behaviour of people when there are differences about the information that they receive.

Exploratory analysis indicated that individuals with higher ambiguity aversion exert less effort under risk and greater effort under ambiguity, although this result is not statistically significant. Just a counterintuitive result is unexpected and warrants further research. We additionally find a surprising result in that participants in the ambiguity treatment that believed they were more likely to have shorter rounds in the second section of the experiment

exerted significantly lower effort than participants who thought they were equally likely or less likely to have shorter rounds.

Further research into how beliefs play into and interact with individuals ambiguity preferences and affect effort provision is necessary to form a wholistic view of how people choose to allocate their effort.

Chapter 3

Effects of Positive and Negative Domains on Effort under Risk and Ambiguity

3.1 Introduction

How much effort people choose to allocate to a task can be influenced by a number of factors, with an important consideration being how costly exerting effort is. One significant factor influencing effort provision and utility calculations is the time cost of effort. When individuals decide how to allocate effort and choose projects or tasks, the perceived time cost of effort becomes crucial.

In much of the effort literature, effort costs are calculated as opportunity costs, with the amount of time needed to complete the task affecting the opportunity cost (Otto and Daw, 2019; Erkal et al., 2018; Georg et al., 2019). But when time costs can change, people must choose how much effort to exert in an uncertain environment. Events outside of the individual's control can occur that will increase the amount of time required to complete a task (such as a group member failing to do their part) or decrease the cost (such as an additional member joining the group).

Individual decisions often depend on whether people perceive outcomes as positive or negative. Research around this idea has found that people's attitudes toward risk can be affected by their perception of outcomes and their own financial position in the moment. Such reference effects are central to Prospect Theory, initially introduced by Kahneman and Tversky in 1979 (Kahneman & Tversky, 2013). Our question focuses on whether there are differences in how people exert effort under risk and ambiguity depending on whether they are in the positive or negative domain.

Kahneman & Tversky's (2013) theory illustrates that individuals tend to be risk-seeking in the domain of losses and risk-averse in the domain of gains. Understanding these behavioural differences has become a critical component of behavioural economics, particularly in distinguishing how people react when faced with potential gains versus losses.

In conjunction with Prospect Theory, earlier studies identified ambiguity aversion through the Ellsberg Paradox (Ellsberg, 1961). Ambiguity aversion suggests that people prefer known risks over unknown risks. Combining these concepts, recent research indicates that reactions to ambiguity versus risk may depend on whether outcomes are framed positively or negatively (Coutts et al., 2023). Although these findings are often presented in the context of monetary outcomes in lottery choices, it is reasonable to extend this behaviour to other factors.

In this chapter, we address this question by comparing participant behaviours in two experiments. Both experiments follow a similar structure with some key differences. There are ten rounds of a real-effort task that participants have to complete in order to receive a bonus payment. The task is split into two sections of five rounds. In the first all rounds are of a known and identical length. The second section has a probability of having all of the rounds be either the same length as section one, or rounds that are a different length of time from section one.

The first experiment examined behaviour in the negative domain, where the rounds in section two can be either the same as section one or longer. The second experiment mirrored the first but focused on the positive domain, where the length of rounds can either be the same as section one or shorter. Our findings suggest that individuals are not generally ambiguity averse in both domains of loss and gains. In the domain of gains, people in both treatments behave similarly, while in the domain of losses people appear to be more ambiguity seeking. Furthermore, participants do not exhibit different levels of effort in the risk treatment regardless of the domain. In both the risk and ambiguity treatments, participants in the negative domain (the first experiment) exhibit greater effort provision.

3.2 Literature review

Gains vs losses and reference effects

Gains and losses have been widely studied in economics, generally showing that there is a significant difference in the way that people behave based on the framing of the outcomes or situation that they find themselves in. Foundational work started with Kahneman & Tversky developing Prospect Theory (1979). This theory posited that value functions are concave for gains and convex for losses, reflecting that people tend to be risk average when outcomes are in the domain of gains and risk-seeking when the outcomes are in the domain of losses. This theory has been validated in several different context, such as consumer behaviour and investment decisions (Kahneman & Tversky, 1992; Benartzi & Thaler, 1995; Camerer et al., 1997).

How gains and losses are perceived is also dependent on an individual's initial starting or reference point. This is termed reference dependence and posits that individuals do not think about gains and losses in absolute terms but in a relative manner. Where they point of reference is can be influenced by a number of factors such as beliefs, expectations or social comparisons (Kahneman & Tversky, 1992; Sugden, 2003; Munro & Sugden, 2003; Bushong & Gagnon-Bartsch, 2023). As effort can be dependent on perceptions about how likely they are to succeed and the potential rewards and costs of success (Gill & Prowse, 2012; Bushong & Gagnon-Bartsch 2023; Burke et al., 2023), reference points can inform how people will exert effort.

An important aspect of the effects from Prospect theory is the idea of loss aversion, which suggests that losses have a greater impact on individual's utility than gains of the same magnitude. This explains why some people may become risk seeking in the domain of losses, as they are trying to avoid feeling loss and so are more willing to engage in risky behaviour or

to increase their effort. Camerer et al. (1997) for example, found that taxi drivers tend to work longer hours on days where their average earnings are lower.

Closely related is the framing effect, as the way that outcomes and domains are framed can influence whether individuals think of outcomes as gains or losses, inducing loss aversion and prospect theory effects. These effects are similarly found in a variety of contexts such as environmental and financial decisions (Kahneman & Tversky, 1981; Homar & Cvelbar, 2021; Maule & Villejoubert, 2020; Gallagher & Updegraff, 2012).

We contribute to the literature on reference effects by exploring how different domains affect how people react to shocks that affect their time cost of effort in risky and ambiguous environments.

Ambiguity aversion

Risk and ambiguity, or uncertainty, are two important and distinct concepts in economics. Risk is defined as a state where the probabilities of events occurring is explicitly known or can be approximated. Ambiguity, on the other hand, refers to a state where the probabilities of the outcomes occurring are unknown. This difference is best illustrated in the seminal work by Ellsberg (1961) where there are two urns both containing 100 balls; one urn has a split of 50 red and 50 black balls (risk), while the other urn has an unknown amount of each colour (ambiguity).

Ellsberg's findings suggest that people prefer bets where the probabilities are known, or risky, rather than where the probabilities are ambiguous when asked to choose between the two; this is termed ambiguity aversion. This effect has been consistently found to be true in different experimental studies in different environments such as finance (Machina and Siniscalchi, 2014; Weber & Tan, 2012).

When looking at differences in specific domains, Cohen et al. (1987) found that in the domain of gains, individuals tend to be more ambiguity averse than in the domain of losses and can be neutral between ambiguity and risk in the domain of losses. Furthermore, framing effects are found to influence ambiguity aversion in that people who feel lucky are more likely to be ambiguity-seeking (Coutts et al., 2023). This finding suggests that the behavioural impacts of ambiguity can vary according to context.

Following the idea that context matters, it is also important to factor in individual's beliefs and how these are updated. As previous studies have found, Drobner and Goerg (2024) find that people update their beliefs asymmetrically due to the ego-relevance of the context and optimism. Similarly, people are found to adopt optimistic beliefs in order to maximize their own utility, which can overpower the effects of ambiguity aversion (Brunnermeier & Parker, 2005).

In this chapter, we draw from the findings in the gains and losses and ambiguity aversion literature to inform our thought process and hypotheses on the differences between the findings of our past two experiments. We add to the literature on effort provision and risk and ambiguity by creating a context where shocks can affect the time cost of effort in a task. We can then see how people will choose to exert effort given different levels of information. This will add valuable insight on how wider behavioural decisions are influenced by events that make it harder to exert effort and if people react in the same way in the real effort domain.

3.3 Experimental Designs and Methods

The designs of the two experiments are similar in their general structure and the way that the treatments work with some key differences. Some structural, presentation and formatting differences are also present in the experiments; these differences came from

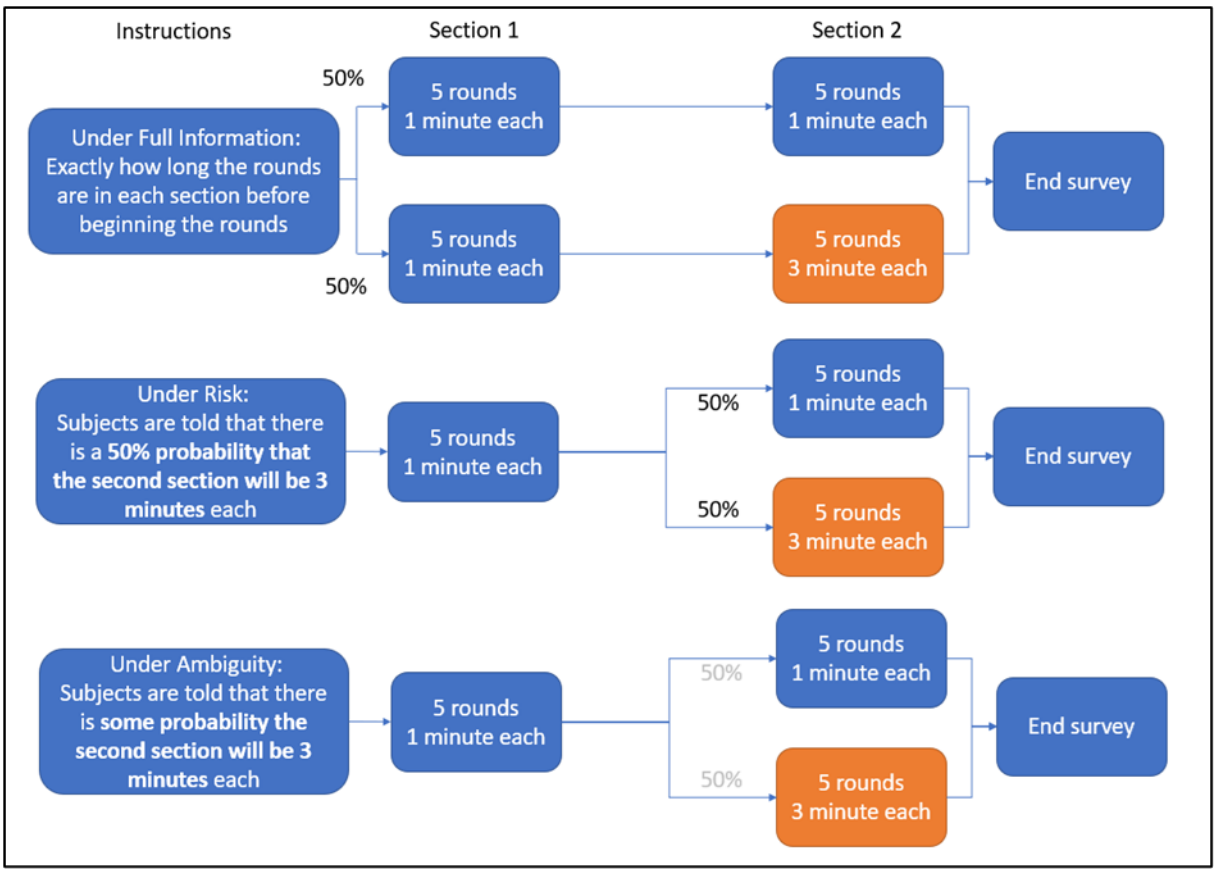
more experience which led to some changes and improvements. However, the fundamentals of the two experiments remain the same.

Both experiments feature ten rounds of a real-effort task that participants have to complete in order to earn a bonus payment. The ten rounds are split into two sections of five rounds each. In each experiment the length of rounds in the first section is the same for all participants in all of the treatments. In section 2 the length of the rounds can either remain the same or be either longer or shorter (longer in experiment one and shorter in the second experiment).

Experiment 1 treatments

The first experiment features three treatments: full information, risk and ambiguity. The three treatments vary in the level of information that is provided to participants about the length of rounds in section 2 (Figure 3.1). In the full information treatment participants

Figure 3.1 – Flowchart showing the structure of experiment 1



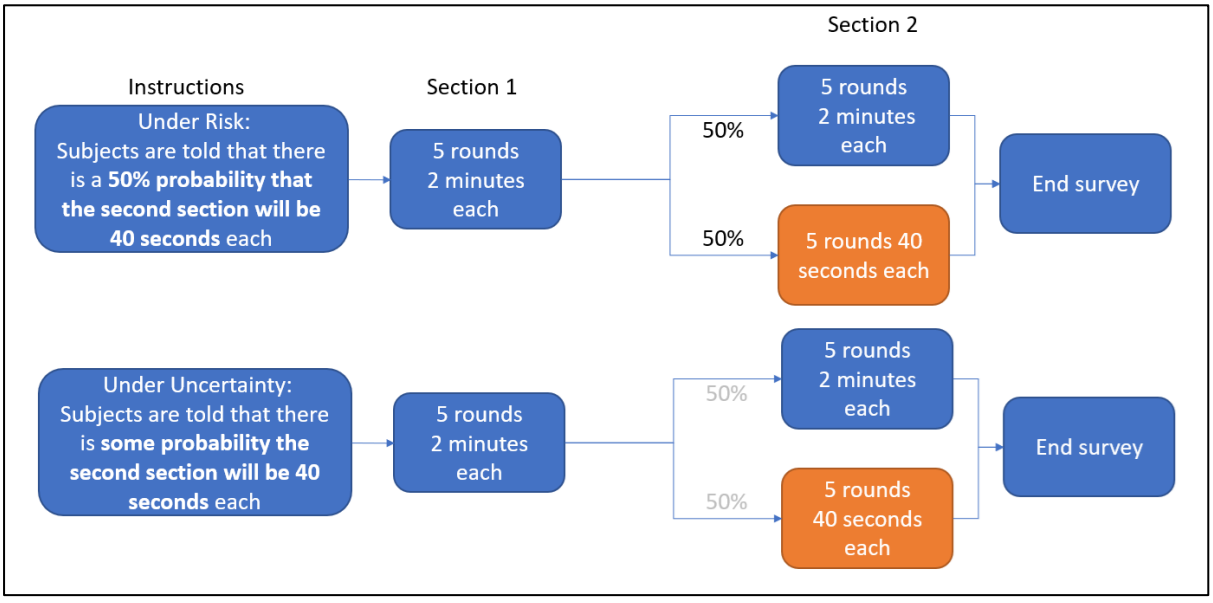
are randomly selected into either having the same length rounds in section 2 as in section 1 or having longer rounds. Specifically, rounds in section 1 are 1-minute long each, while rounds in section 2 can either be 1-minute long or 3-minutes long. Participants in this treatment are given complete information as to the length of rounds in each section.

In the risk treatment, participants are assigned to either have longer or same length rounds after the first section. They are told before beginning that there is a 50/50 chance to have longer or same-length rounds. In the ambiguity treatment, participants are similarly assigned to either outcome state of the treatment after section 1 but are only told that there is some unknown chance of the rounds being longer or the same length. For all participants the probability of having longer rounds in section 2 is always 50%.

Experiment 2 treatments

In the second experiment there are two treatments: risk and ambiguity (Figure 3.2). In this experiment, participants have a 50% chance to either have the same length rounds as in section 1, or shorter rounds. Rounds in section 1 are 40-seconds long, while in section 2 they can be either 40-seconds or 2-minutes long. As before participants learn the state of the

Figure 3.2 – Flowchart showing the structure of experiment 2



world after completing section 1, but only know that the two outcomes are possible beforehand.

Similarly to the risk treatment in the first experiment, participants are told that there is a 50/50 chance to have shorter or same length rounds in section 2, while participants in the ambiguity treatment. This information is presented in the form of a marble being drawn from a bag containing 100 marbles. For the risk treatment, participants are told that there are 50 white and 50 black marbles and for the ambiguity treatment they are told that the distribution is unknown.

Differences in payoffs and time

While the two experiments parallel each other closely in their structure and the task, there are a few differences as to the payoffs and length of rounds. Firstly, while experiment one has rounds that are 1-minute in length, and then either 1 or 3-minutes in length, the second experiment has rounds that are 2-minutes in length and then either 2-minutes or 40-seconds in length. The main reason for changing the length of time that rounds take between the two rounds is that keeping the timing the same in the second experiment would greatly inflate the overall length of the experiment, which would make comparison more difficult.

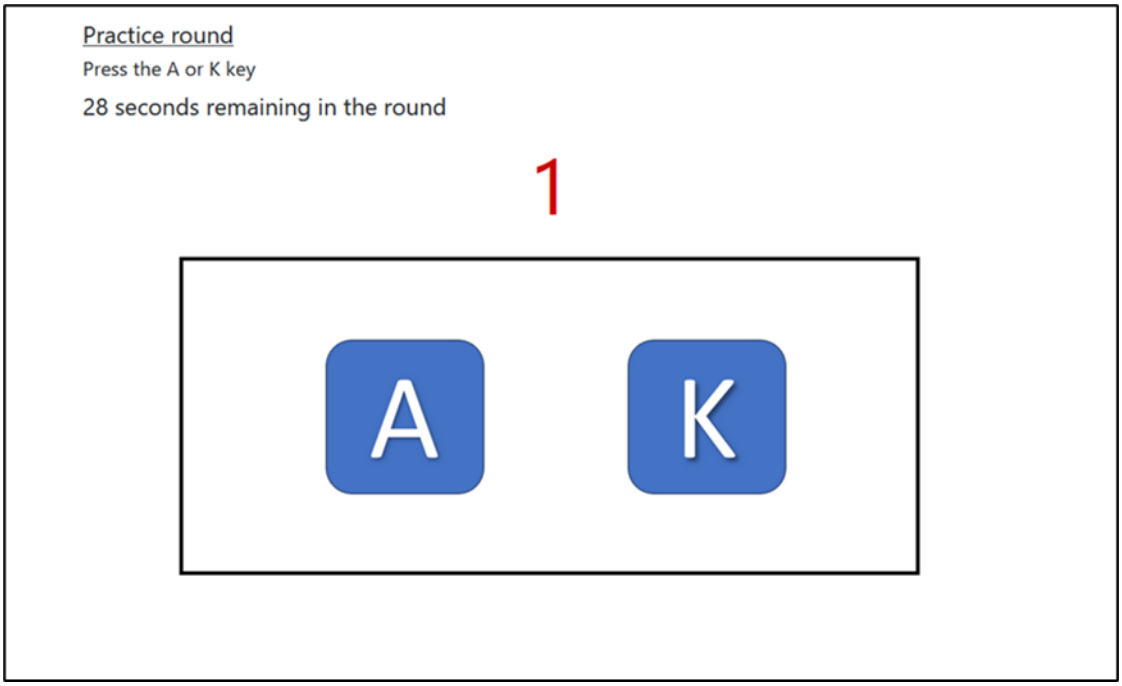
By changing the length of time rounds take as we did, we maintain a 1:3 ratio between long and short rounds and also maintain a similar total length of time that the experiment takes regardless of whether participants find themselves in the positive or negative state of the world. In the first experiment, the minimum length of time that participants will work on the task if they complete all rounds is 10 minutes, while the maximum length of time spent on the task is 20 minutes. Similarly, the minimum length of time that participants will spend on the task in the second experiment is about 13 minutes, while the maximum length of time is 20 minutes. This is as close as we could get to maintaining similar minimum and maximum

lengths of time while also having a 1:3 ratio between long and short rounds to maintain a consistent psychological impact in the difference of time length.

The task

The real-effort task used in both experiments is identical. Participants are required to alternately press the "A" and "K" keys on their keyboard for the duration of the round (Figure 3.3). Participants can begin with either key but must then press the alternate key. Along with the round timer, the task features a key-press timer that counts down from 3 and refreshes after each key press. Participants must press the next key before the timer runs out in order to complete the round. If participants fail to press the next key within the 3-second window they will fail the round and will not be able to continue to the next round. By using the 3-second task timer, we ensure that participants are providing a minimum consistent level of effort for the entire duration of the task.

Figure 3.3 – Screenshot of the effort task as participants see it during the experiments



It is important to note that in both experiments, participants have the option to stop working on the task rounds at any point and skip to the end surveys. By doing so, participants

forfeit the bonus payment but still receive participation payment. In this way, participants can decide whether they believe the costs outweigh the potential benefits of the bonus payment.

Both experiments were coded using the o-Tree software and participants were recruited using Prolific. On average participants took about 30 minutes to complete the experiment in both cases with large variation across subjects due to the nature of the treatments and the fact that participants have the option to skip the task rounds altogether.

3.4 Results

Experiment 1 had a combined sample of 444 with 292 participants being in the risk and ambiguity treatments and the rest of participants in the full information treatment. Experiment 2 had a combined sample of 394. Table 3.1 and Table 3.2 show balance tables for each experiment respectively. These balance tables include the average total rounds completed by participants, the average total key presses, risk measure and perseverance measure. The tables also show whether there is any significant difference between the treatments. We will be comparing the round completion of participants in the risk and ambiguity treatments between the experiments.

Table 3.1 – Balance table for experiment 1

	(1) Full information treatment	(2) Risk treatment	(3) Ambiguity treatment
keys_total	2333.60	1992.36	2291.54
	(2073.47)	(1972.80)	(1768.60)
perseverance	3.27	3.33	3.26
	(0.70)	(0.74)	(0.67)
risk_measure	11.02	10.43	10.36
	(5.56)	(4.76)	(5.35)
imi_measure	2.86	2.80	2.84
	(0.46)	(0.45)	(0.50)
N	152	147	145

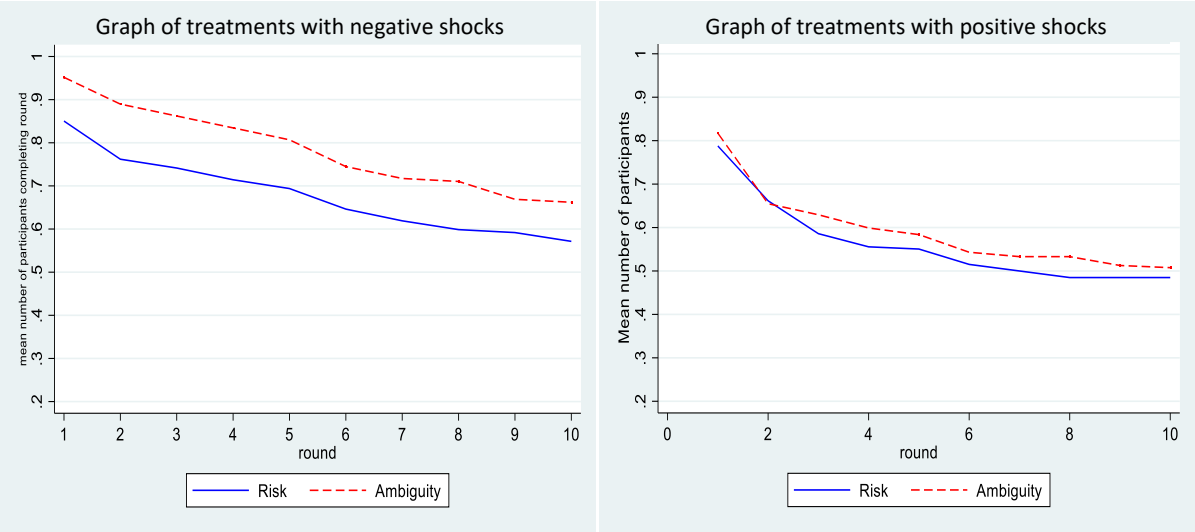
Table 3.2 – Balance table for experiment 2

	(1) Risk treatment	(2) Ambiguity treatment	(3) Difference (1)-(2)
total key presses	1906.96	2143.39	-236.42
	(1995.36)	(2101.85)	(206.51)
risk_measure	9.82	9.97	-0.15
	(5.72)	(6.40)	(0.61)
ambiguity aversion score	3.75	3.67	0.08
	(1.12)	(1.10)	(0.11)
intrinsic	2.10	2.33	-0.24**
	(0.96)	(1.01)	(0.10)
N	198	196	394

In the first experiment, participants in the risk treatment completed 6.79 rounds on average, while participants in the ambiguity treatment completed 7.85 rounds on average. In the second experiment participants in the risk treatment completed 5.61 rounds on average, while participants in the ambiguity treatment completed 5.94 rounds on average. Immediately we can see that participants in first experiment exerted greater effort on average compared to participants in the second experiment. Figure 3.4 shows the average number of participants that completed each round by treatment for the first and second experiment

respectively. We can see that the slopes of the graph in the second experiment are generally lower than those in experiment 1, indicating lower effort provision in experiment 2.

Figure 3.4 – Graphs showing the percentage of participants completing each round by treatment



Using t-tests we find that there is a significant difference between the average number of rounds completed in the risk treatment between experiments. Specifically, we find that the average number of rounds completed in the risk treatment is lower in the second experiment than in the first (p=0.013). Similarly, we find that the average number of rounds completed in the ambiguity treatment is lower in the second experiment than in the first (p=0.00).

We also find that between the two experiments, while about the same number of participants in the risk treatment completed round 1, experiment 1 appears to have a significantly higher round 1 completion in the uncertainty treatment. We conduct a t-test to determine if this difference is significant and find that round 1 completion is significantly lower in experiment 2 for the uncertainty treatment (p=0.00).

The results of an OLS regression controlling for the experiment is shown in Table 3.3. Our previous conclusions are supported, showing that participants in the ambiguity treatment exert greater effort (post estimation t-test p=0.032), but only in experiment 1, while there is no difference between the treatments in experiment 2 (this is shown by the interaction

between the treatment and experiment dummy). Furthermore, the regression confirms that experiment 2 had lower overall effort than experiment 1 (post estimation t-test p=0.056).

Table 3.3 – OLS regression of total rounds completed on treatment and experiment dummy

	model 1	model 2	model 3	model 4
Ambiguity	1.059**	1.041**	1.041**	1.052**
	(0.491)	(0.490)	(0.491)	(0.489)
Experiment 2	-1.178**	-1.172**	-1.170**	-3.182**
	(0.456)	(0.456)	(0.457)	(1.589)
Ambiguity X Experiment 2	-0.731	-0.697	-0.696	-0.757
	(0.647)	(0.647)	(0.647)	(0.644)
Male		-0.436	-0.434	-0.509
		(0.320)	(0.321)	(0.321)
Non-binary		-3.742	-3.759	-3.029
		(2.432)	(2.445)	(2.446)
Age			-0.00947	-0.0897
			(0.128)	(0.131)
Expeiment 1 X Perseverance				0.279
				(0.354)
Experiment 2 X Perseverance				0.885***
				(0.301)
Constant	6.789***	7.017***	7.055***	6.491***
	(0.346)	(0.384)	(0.639)	(1.249)
Observations	686	686	686	686

Notes: The displays an OLS regression with the number of rounds participants passed as the dependent variable. Results are displayed first regressing the number of rounds passed on the treatment and then adding the experiment dummy. We interact the treatment with the experiment dummy to find how treatments differ between the two experiments. Controls are added in subsequent models with the final model featuring a control for perseverance that is interacted with the experiment.
Standard errors are displayed in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Looking into perseverance we first examine the distribution of perseverance scores between the treatments in each experiment. Kolmogorov-Smirnov tests indicate that the distributions are not significantly different from each other (p=0.88 for risk, p=0.49 for uncertainty). Next, we split the distributions into high and low perseverance scores to check whether there are any differences in effort between experiments in each treatment for low perseverant and high perseverant individuals.

We find that on average participants with higher perseverance complete more rounds in both experiments in the risk treatment. In the uncertainty treatment this is only true for the second experiment. Within each experiment these differences between the average number of rounds completed between the high perseverant and low perseverant individuals in each treatment are not significant.

Our results suggest that people in the risk treatment behave similarly in both the domain of losses and gains in the first round, or in the uptake of the task. However, from our analysis on round 1 completion, people are more likely to engage in the task under ambiguity in the domain of losses than they are in the domain of gains. Furthermore, we find that in general in the ambiguity treatment participants exert more effort in the domain of losses than in the domain of gains. In the risk treatment participants exert similar effort in both domains.

3.5 Discussion

Unlike what we predicted we find that individuals are not generally ambiguity averse in both domains of loss and gains relative to risk. In fact, we find that in the domain of gains, people in both treatments behave similarly, while in the domain of losses people appear to be more ambiguity seeking.

Furthermore, we find that there are no significant differences between how people perform in the risk treatment between the two experiments. This would appear to go against what findings generally suggest from the prospect theory and reference effect literature. On the other hand, we find that participants are more ambiguity seeking in the domain of losses as compared to the domain of gains. This result is consistent with the findings of Cohen et al. (1987) in that people are more ambiguity averse in the domain of gains than the domain of losses. At the same time, our results differ from their findings as we do not find that participants are indifferent between risk and ambiguity in the domain of losses.

It is interesting that we do not find the same sort of differences in the way that people react to risk as would be expected from the wider literature and theory between the two domains. It could be that people do not perceive risk in the same way when effort costs are involved versus when there are differences in monetary outcomes. At the same time we find evidence for a strong difference in the way that people react to uncertainty between the two domains.

3.6 Conclusion

In conclusion, our study investigates the influence of loss and gain domains on economic behaviour, specifically focusing on risk and ambiguity in the context of effort-related outcomes. We conducted two experiments to compare behaviours in the negative domain (increased cost of effort) and the positive domain (decreased cost of effort) under both risky and uncertain conditions. Our findings provide several important insights into the decision-making processes under different conditions of risk and ambiguity.

Contrary to our initial hypothesis, our results reveal that individuals are not uniformly ambiguity averse in both domains of gains and losses relative to risk. Notably, we observed that participants behaved similarly under risk in both domains but displayed a greater tendency towards ambiguity seeking in the domain of losses compared to gains.

Moreover, our results suggest that participants' behaviour under risk is consistent across both experiments, indicating that the perception of risk does not significantly differ when the cost of effort is involved compared to monetary outcomes. This contrasts with established theories from Prospect Theory and reference effect literature, which typically predict greater risk aversion in the domain of gains and risk seeking in the domain of losses.

Our study adds a novel dimension to the existing literature by examining these effects in the context of effort costs rather than monetary payoffs. The strong differences in reactions

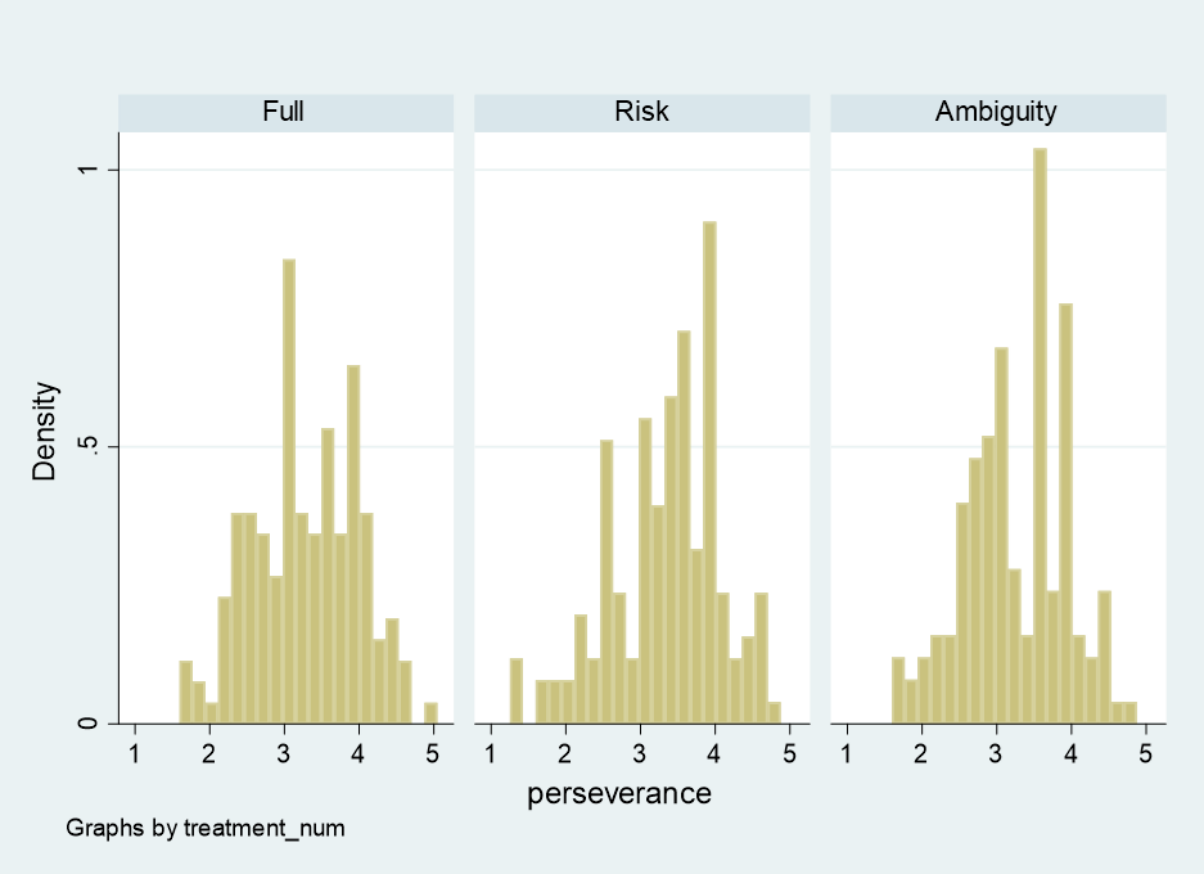
to uncertainty between the domains of gains and losses highlight the complexity of economic decision-making and suggest that context significantly influences behaviour. These insights could have important implications in how we understand behaviour under risk and uncertainty in working environments.

Future research could further explore the underlying mechanisms driving these behaviours and investigate whether similar patterns hold in other real-world settings. Additionally, examining individual differences in sensitivity to risk and ambiguity across various contexts could provide a more comprehensive understanding of economic behaviour.

Annex

Annex 1 – Chapter 1 additional material

Figure 4.1 - Distribution of perseverance scores by treatment



Annex 2 – Chapter 2 additional material

Figure 4.2 - Distribution of stated beliefs for having shorter rounds in section 2 by treatment

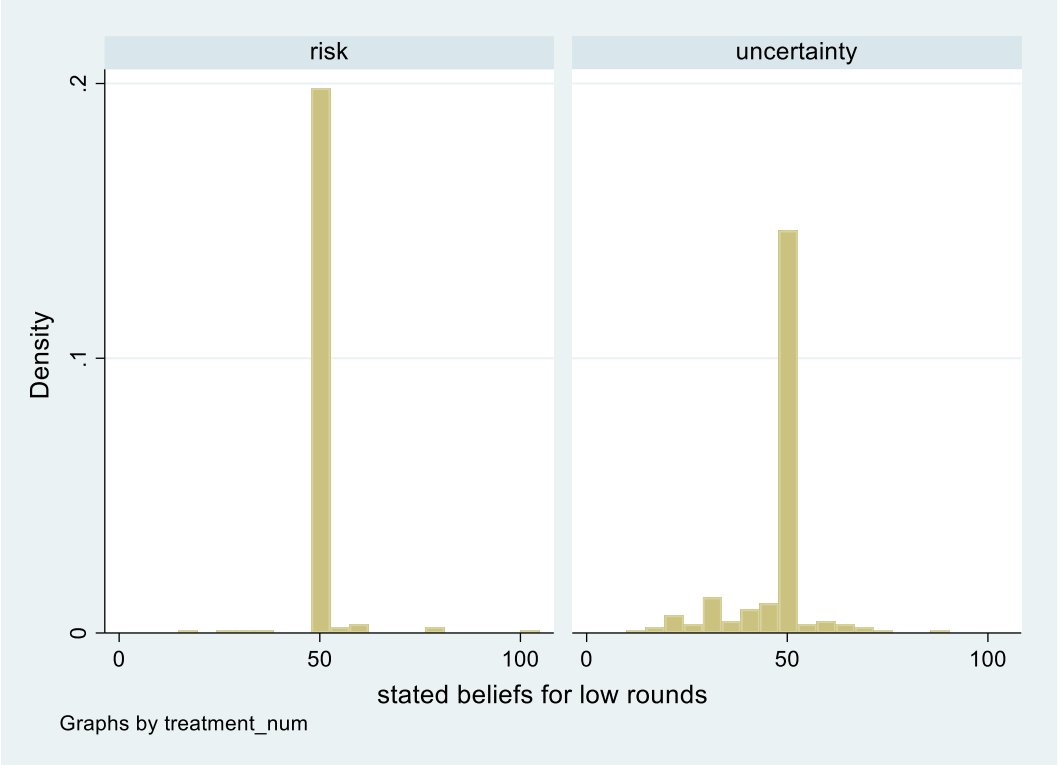


Figure 4.3 - Histogram for the distribution of total rounds completed by treatment

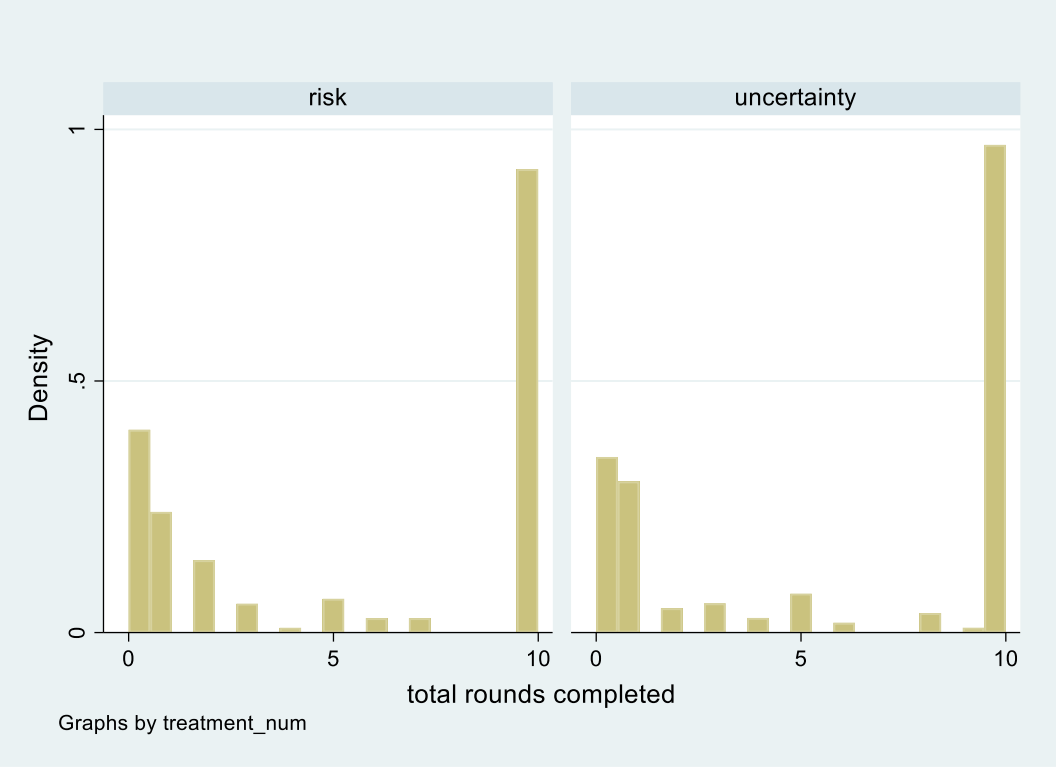
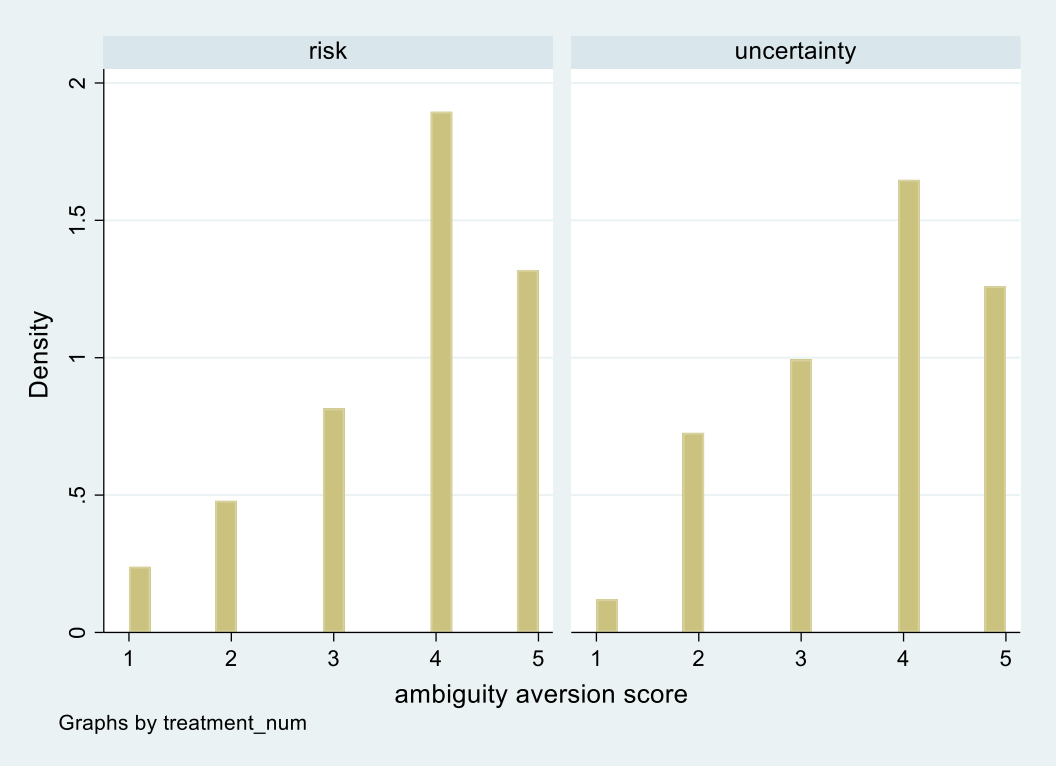
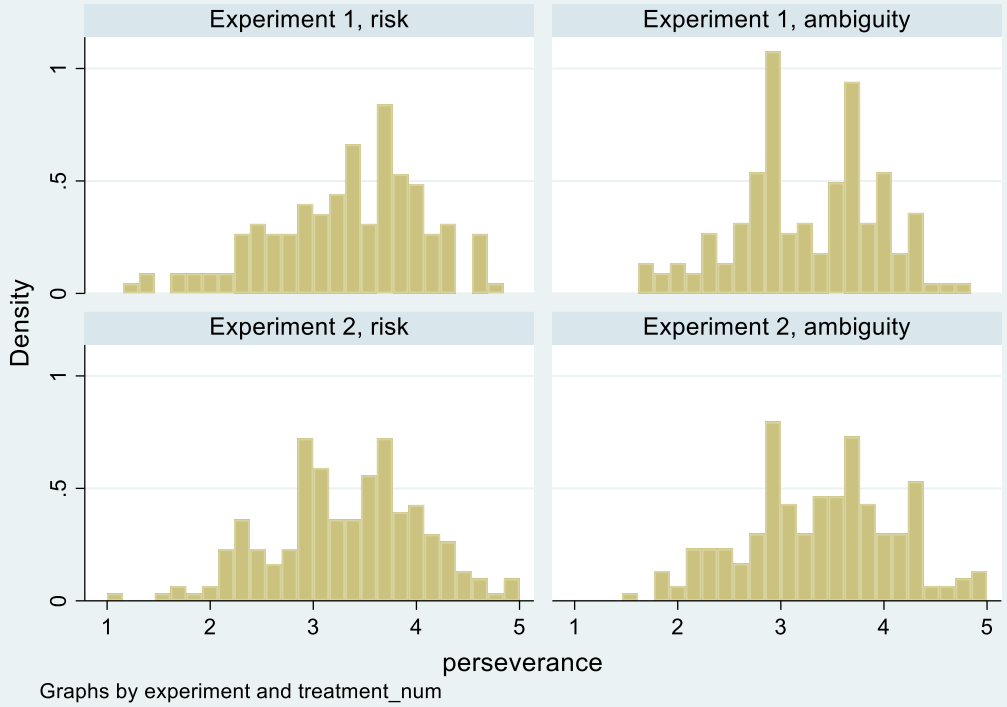


Figure 4.4 - Distribution of ambiguity aversion score by treatment



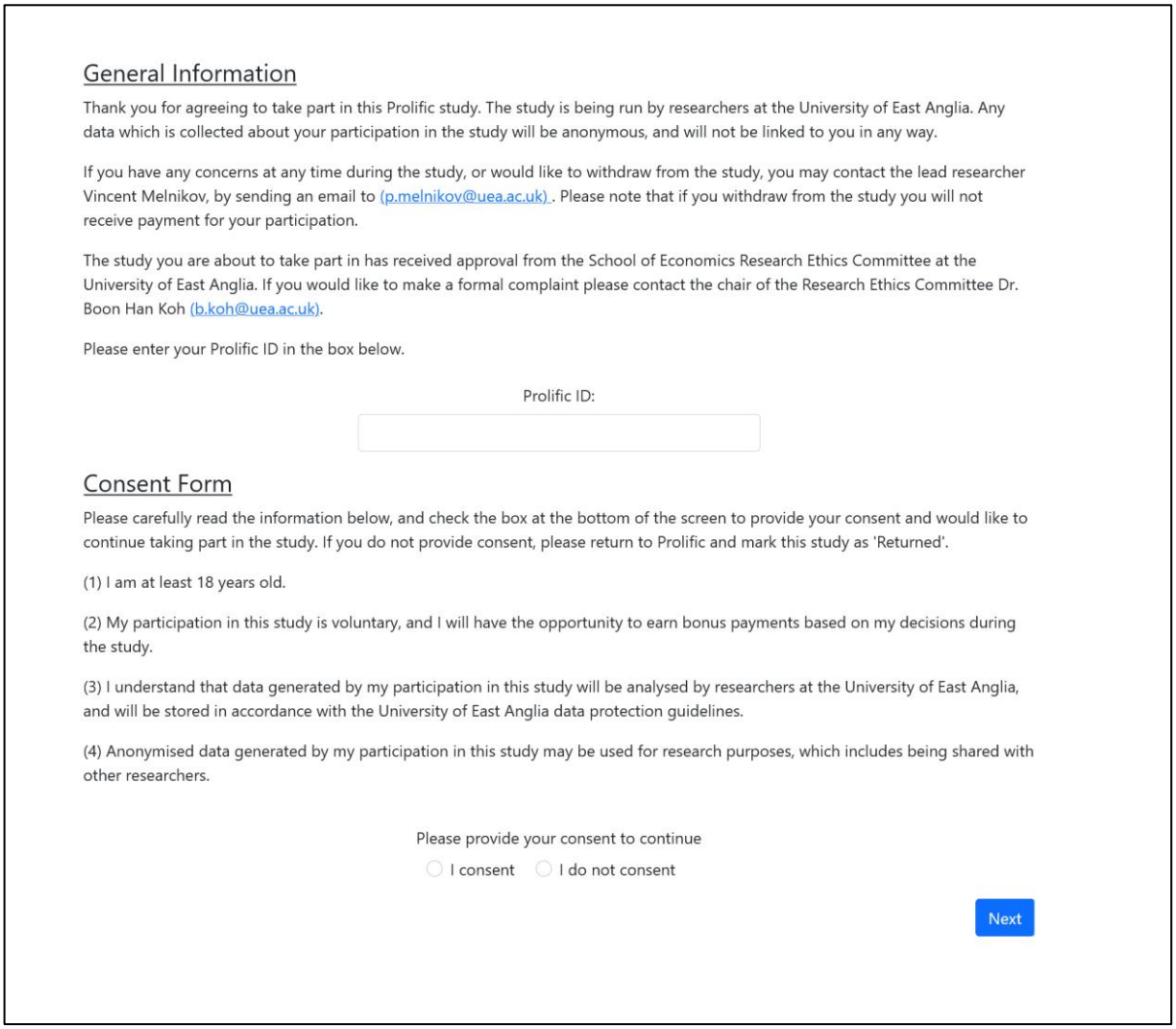
Annex 3 – Chapter 3 additional material

Figure 4.5 - Histograms showing the distribution of perseverance scores in each experiment and treatment



Annex 4 – Experiment 1 screenshots

Consent page



General Information

Thank you for agreeing to take part in this Prolific study. The study is being run by researchers at the University of East Anglia. Any data which is collected about your participation in the study will be anonymous, and will not be linked to you in any way.

If you have any concerns at any time during the study, or would like to withdraw from the study, you may contact the lead researcher Vincent Melnikov, by sending an email to (p.melnikov@uea.ac.uk) . Please note that if you withdraw from the study you will not receive payment for your participation.

The study you are about to take part in has received approval from the School of Economics Research Ethics Committee at the University of East Anglia. If you would like to make a formal complaint please contact the chair of the Research Ethics Committee Dr. Boon Han Koh (b.koh@uea.ac.uk).

Please enter your Prolific ID in the box below.

Prolific ID:

Consent Form

Please carefully read the information below, and check the box at the bottom of the screen to provide your consent and would like to continue taking part in the study. If you do not provide consent, please return to Prolific and mark this study as 'Returned'.

(1) I am at least 18 years old.

(2) My participation in this study is voluntary, and I will have the opportunity to earn bonus payments based on my decisions during the study.

(3) I understand that data generated by my participation in this study will be analysed by researchers at the University of East Anglia, and will be stored in accordance with the University of East Anglia data protection guidelines.

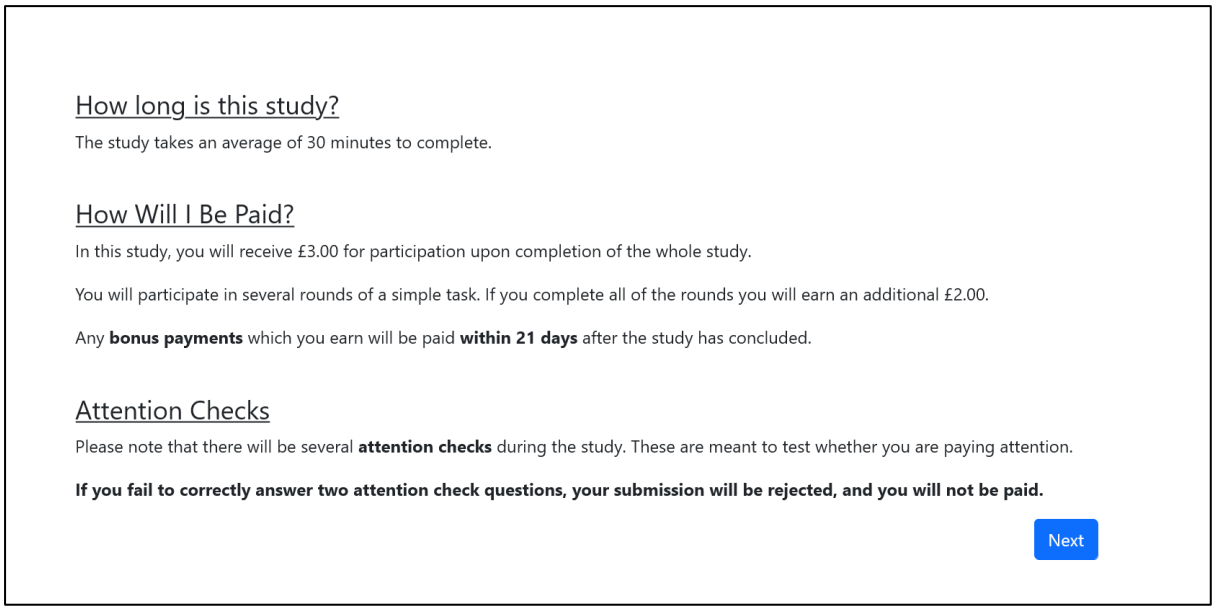
(4) Anonymised data generated by my participation in this study may be used for research purposes, which includes being shared with other researchers.

Please provide your consent to continue

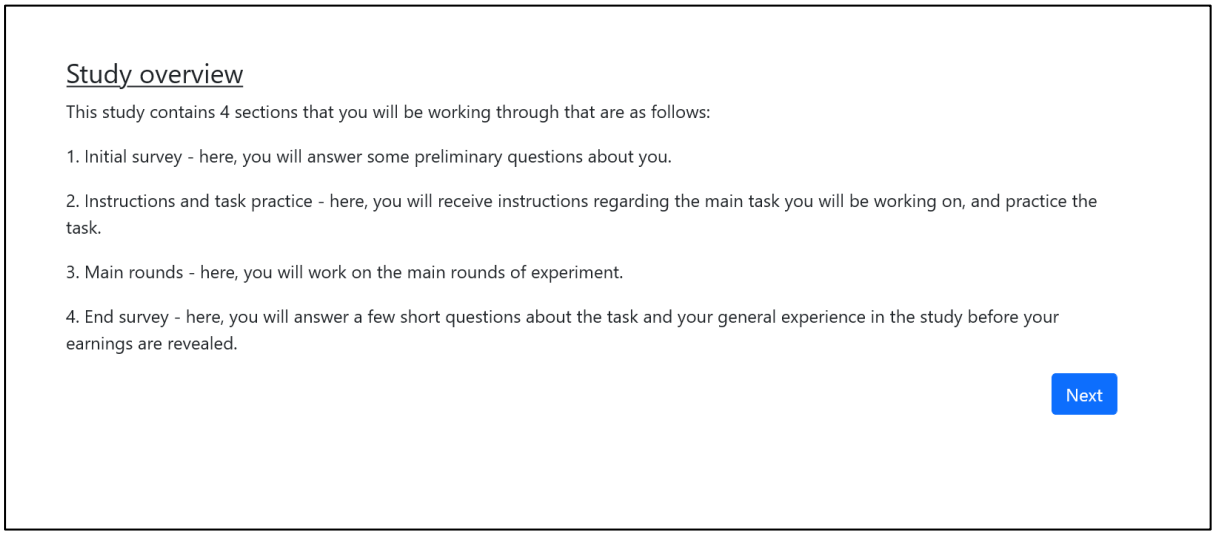
I consent I do not consent

Next

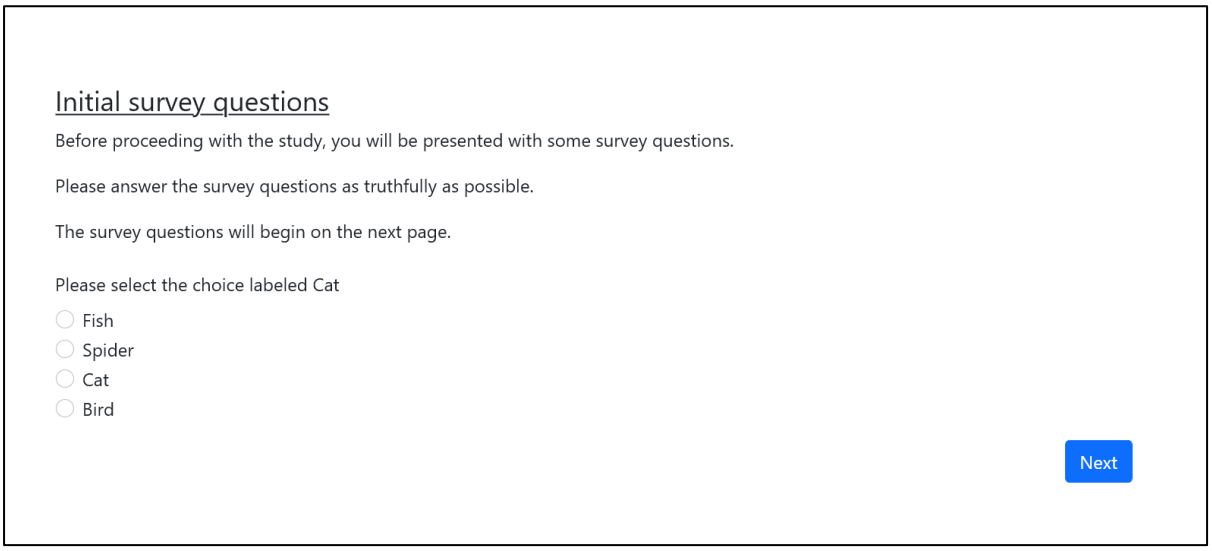
General information page



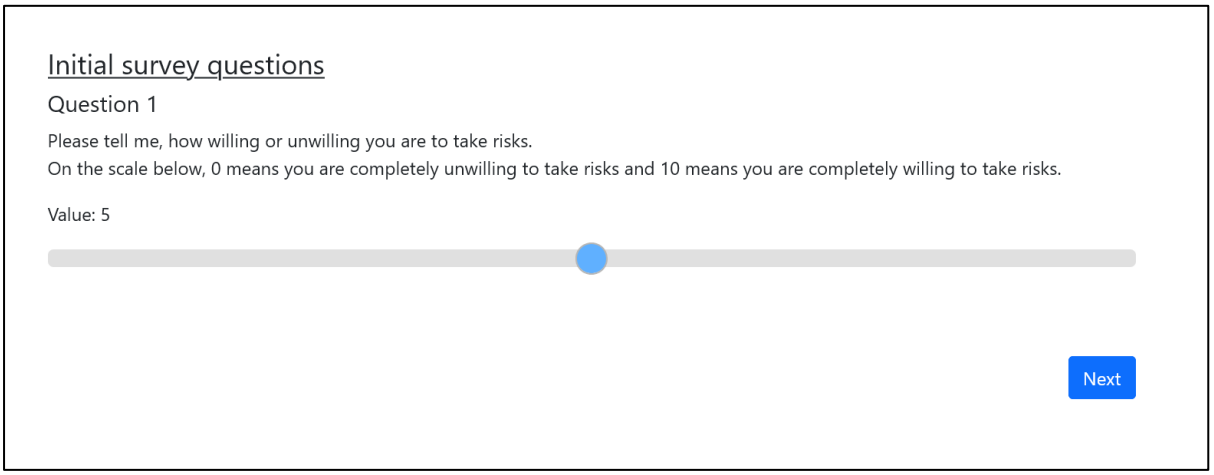
Overview page



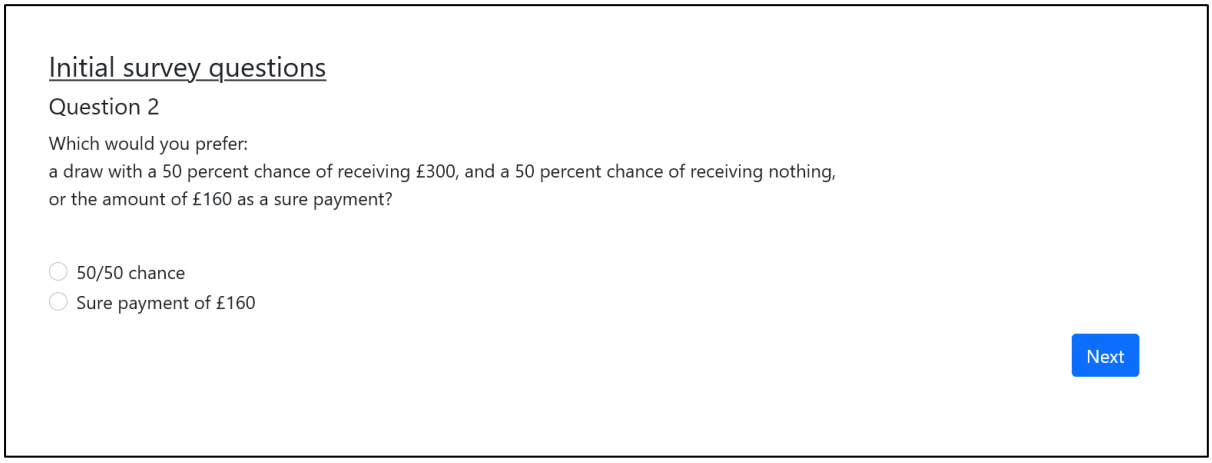
Attention check page with survey introduction



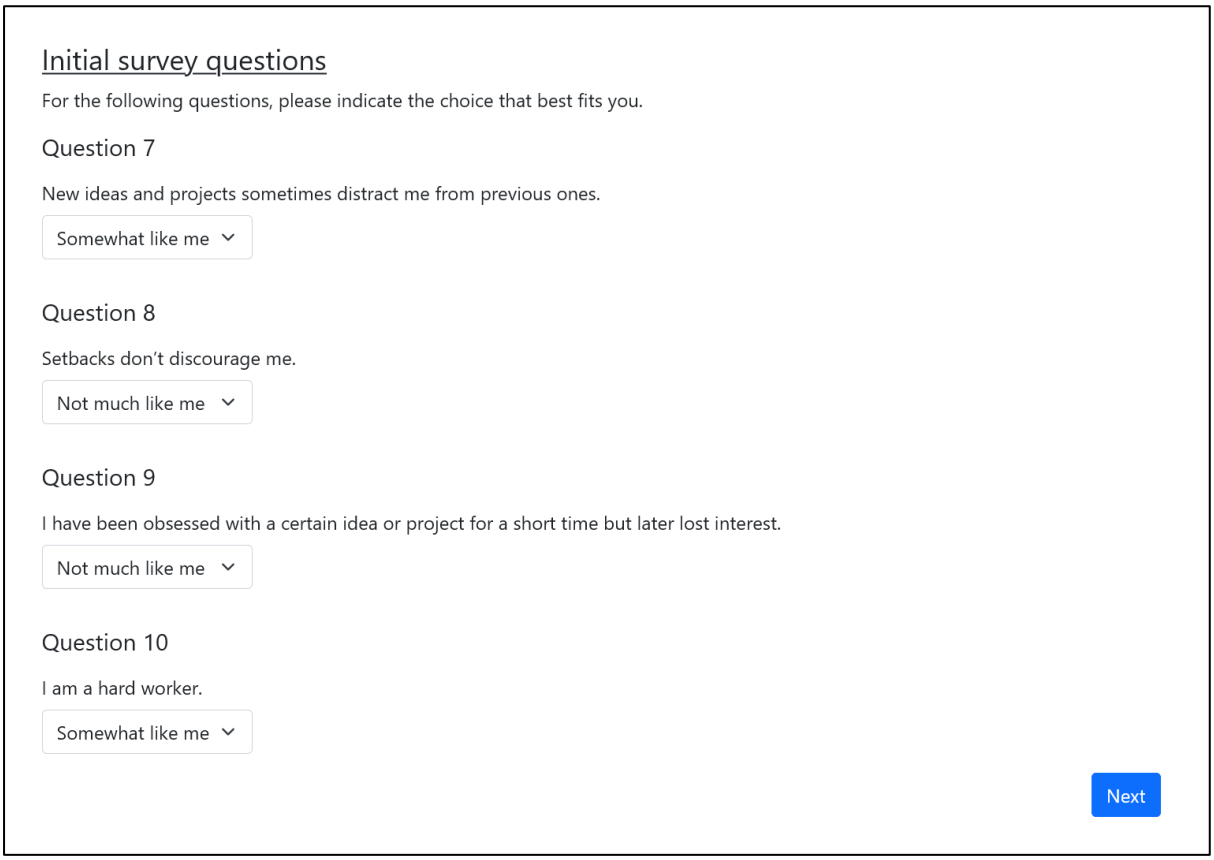
Question 1 for risk measure elicitation

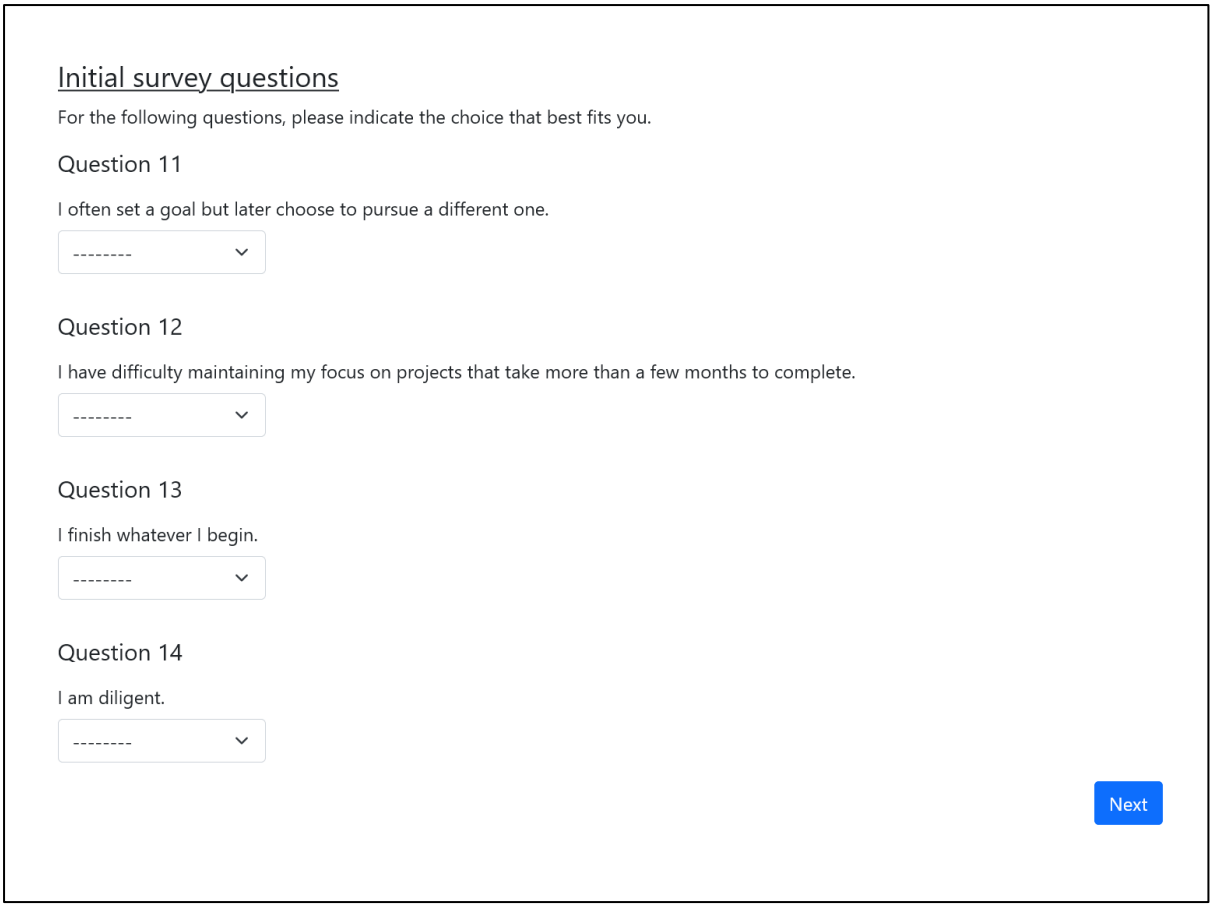


Question 2 for risk measure elicitation (there are 6 questions total similar to question 2)

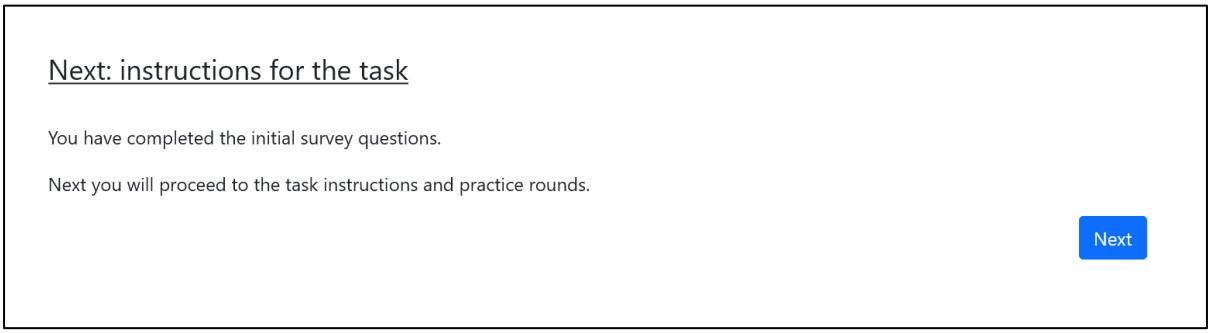


Pages for perseverance elicitation questionnaire





Task instructions pages



Key-press task

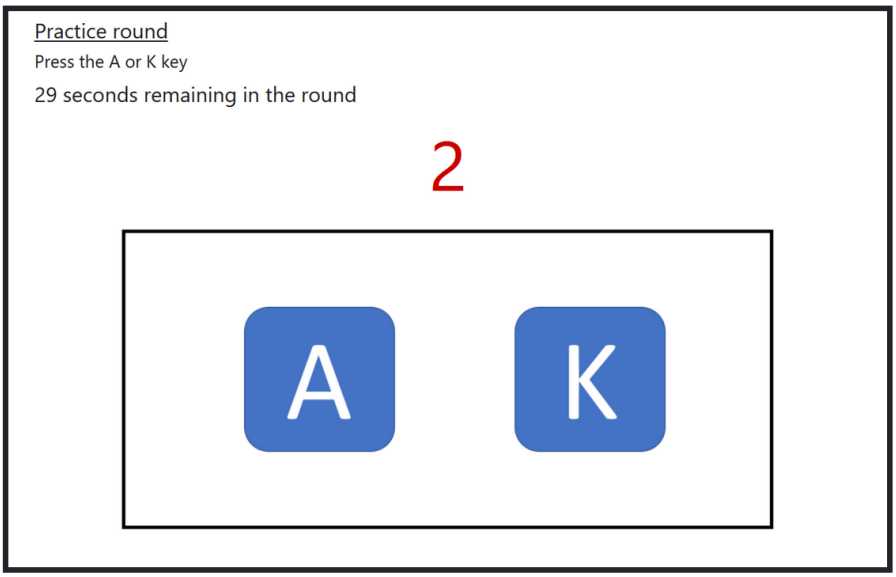
During this study, you will be engaging in several rounds of a simple key-pressing task. The objective of the task is to alternately press the 'a' and 'k' keys on your keyboard (i.e., first you press 'a', then 'k', then 'a', and so on).

You must continuously alternate between pressing the two keys for the duration of the task. **No more than 3 seconds** can elapse between pressing the keys.

A timer will be shown on the screen counting down from 3 to 0, and it will refresh each time you press the correct key. You must therefore enter the correct key before the countdown reaches 0.

If the timer reaches 0 before you press the next key, the task will automatically end, and you will move on to the final section of the study. You will not be able to work on any of the subsequent rounds and **you will not receive the £2.00 bonus payment**. You will receive the participation payment.

Below is an example for the task:



Next

Task instructions comprehension test

Comprehension test

Please answer the following questions in relation to the instructions which you just read. If you fail to correctly answer any of the questions, you will not be able to proceed.

You may re-read the instructions at any time by pressing the button below.

Task instructions

What do you need to do during the task?

- Alternately press the 'a' and 'k' buttons on the keyboard.
- Press random buttons on the keyboard.
- Continuously press the spacebar button.
- Press the 'a' and/or 'k' buttons on the keyboard in any order.

At most, how much time can elapse between each key press?

- 5 seconds
- 10 seconds
- 2 seconds
- 3 seconds

What happens if the timer between key presses reaches 0?

- The task is counted as incomplete and bonus payment will not be received.
- The task starts over and you may still receive bonus payment.
- The task ends and you may still get bonus payment.
- The next task begins but you will not receive bonus payment.

Next

Pages for practice task unpaid and paid

Practise the task

Before we continue with the instructions, you will have the opportunity to practise the task for 30 seconds.

Please note that your performance during this round will not affect your payment for the study. The purpose of the practice round is for you to have an opportunity to become familiar with the task.

If you would like a reminder of the instructions for the task, press the button below.

Task instructions

During this practice session you will not be penalised for the 3-second timer running out but will be notified when you have not pressed the appropriate key in the time required

Once you begin the practice task, you will not be able to pause it. Please make sure that you are ready to take part in the practice task before you begin.

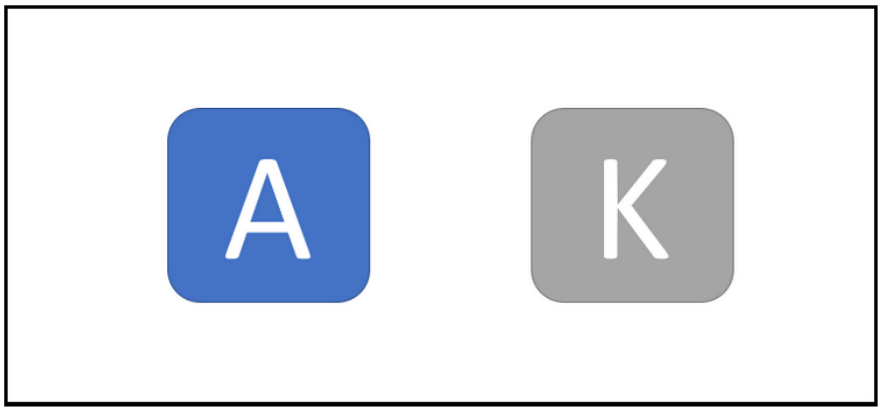
Please click on the next button to start the practice task.

Next

Practice round

17 seconds remaining in the round

1



Paid practice

The first practice task is now complete

Next, you will take part in a **paid practice** task. This time, if you complete the task, you will earn an additional £0.02 to your total payment.
However, if the 3-second timer reaches 0, the round will end, and you will not earn the additional payment.

As before, the round will last 30 seconds.

You may re-read the instructions by pressing the button below.

Task instructions

Please click on the next button to start the practise task.

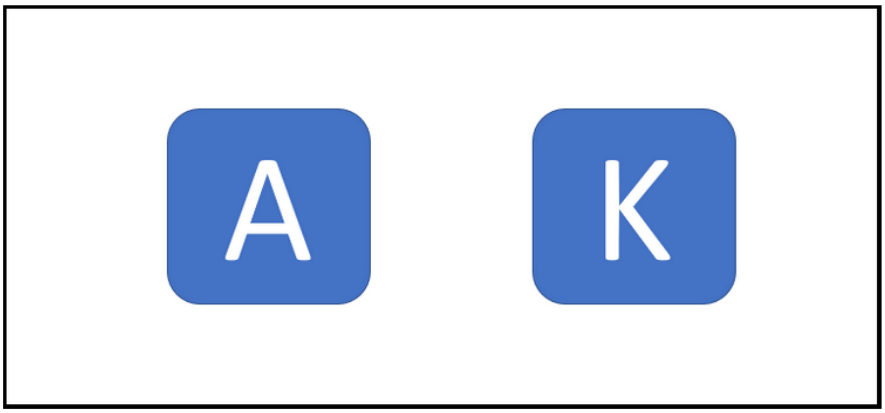
Next

Paid practice round

Press the A or K key

28 seconds remaining in the round

1



General instructions pages

Next: instructions for the main rounds

The paid practice is now complete.

You will now receive instructions for the next part of the study.

Please select the choice labeled Spider

- Fish
- Spider
- Cat
- Bird

Next

Instructions for full information treatment

General instructions

During the following part of the study, you will participate in 10 rounds of the key-press task.

The first **5 rounds** of the task will be **1 minute** each. The **second 5 rounds** will be **1 minute each**.

Rounds 1-5	Rounds 6-10
1 minute	1 minute

In order to complete this study **and receive the £2.00 bonus payment** , you will need to complete **all of the** rounds and complete a few short survey questions about the task at the end of the study.

While you are working on the tasks, there will be a button that will allow you to stop working and skip to the survey questions. You may stop working on the task rounds at any time if you wish. If you do so, **you will receive the participation payment upon completion of the final sections, but you will not receive the bonus payment**.

Next

Comprehension test

Please answer the following questions, related to the instructions which you have just read. If you fail to correctly answer any of the questions, you will not be able to proceed.

You may re-read the instructions at any time by pressing the button below.

General instructions

How many rounds do you need to complete to receive the bonus payment?

- ○ 5
- ○ 1
- ◉ 10
- ○ 20

How long are the first 5 rounds?

- ○ 2 minutes
- ○ 1 minute
- ○ 3 minutes
- ○ 5 minutes

How long are the second 5 rounds?

- ○ 1 minute
- ○ 2 minutes
- ○ 3 minutes
- ○ 4 minutes

When can you choose to stop working on the task rounds?

- ○ At any point.
- ○ After completing the round you are working on.
- ○ At the end of the study.

Next

Round 1 start screen for full information treatment

Round 1 of 10

You will now begin round 1. There are 10 total rounds.

The first 5 rounds are 1 minute each, the second 5 rounds will be 1 minute each.

Remember, if you wish to stop working on the tasks and proceed to the final sections of the study you may do so by pressing the **"Skip rounds and proceed to survey"** button at the bottom of the screen during the task.

You may also choose to proceed to the survey questions now by pressing the **"Skip rounds and proceed to survey"** button. You will have this opportunity before each round that you begin. If you do so you will not receive the bonus payment.

If you wish to begin the first round, press the **"Start round" button.**

Skip rounds and proceed to survey

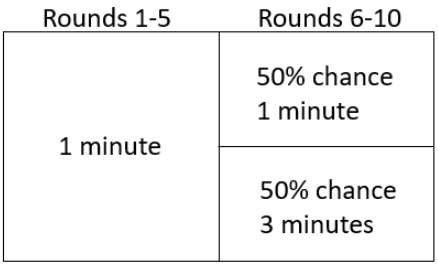
Start round

Instructions for the risk treatment

General instructions

During the following part of the study, you will participate in 10 rounds of the key-press task.

The first **5 rounds** of the task will be **1 minute** each. After the first 5 rounds the **second 5 rounds** will have a **50% chance** to have **3 minute** rounds and a **50% chance** to have **1 minute** rounds.



In order to complete this study **and receive the £2.00 bonus payment** , you will need to complete **all of the** rounds and complete a few short survey questions about the task at the end of the study.

While you are working on the tasks, there will be a button that will allow you to stop working and skip to the survey questions. You may stop working on the task rounds at any time if you wish. If you do so, **you will receive the participation payment upon completion of the final sections, but you will not receive the bonus payment**.

Next

Comprehension test

Please answer the following questions, related to the instructions which you have just read. If you fail to correctly answer any of the questions, you will not be able to proceed.

You may re-read the instructions at any time by pressing the button below.

General instructions

How many rounds do you need to complete to receive the bonus payment?

- 5
- 1
- 10
- 20

How long are the first 5 rounds?

- 2 minutes
- 1 minute
- 3 minutes
- 5 minutes

How long are the second 5 rounds?

- 50% chance 1 minute and 50% chance 2 minutes
- 50% chance 1 minute and 50% chance 3 minutes
- 50% chance 1 minute and 50% chance 4 minutes
- 50% chance 1 minute and 50% chance 5 minutes

When can you choose to stop working on the task rounds?

- At any point.
- After completing the round you are working on.
- At the end of the study.

Next

Instructions for the ambiguity treatment

General instructions

During the following part of the study, you will participate in 10 rounds of the key-press task.

The first **5 rounds** of the task will be **1 minute** each. After the first 5 rounds, the **second 5 rounds** will have **some chance** to have **3 minute** rounds and **some chance** to have **1 minute** rounds.

<table>
<tr><th>Rounds 1-5</th><th>Rounds 6-10</th></tr>
<tr><td rowspan="2">1 minute</td><td>Some % chance
1 minute</td></tr>
<tr><td>Some % chance
3 minutes</td></tr>
</table>

In order to complete this study **and receive the £2.00 bonus payment** , you will need to complete **all of the** rounds and complete a few short survey questions about the task at the end of the study.

While you are working on the tasks, there will be a button that will allow you to stop working and skip to the survey questions. You may stop working on the task rounds at any time if you wish. If you do so, **you will receive the participation payment upon completion of the final sections, but you will not receive the bonus payment**.

Next

Comprehension test

Please answer the following questions, related to the instructions which you have just read. If you fail to correctly answer any of the questions, you will not be able to proceed.

You may re-read the instructions at any time by pressing the button below.

General instructions

How many rounds do you need to complete to receive the bonus payment?

- 5
- 1
- 10
- 20

How long are the first 5 rounds?

- 2 minutes
- 1 minute
- 3 minutes
- 5 minutes

How long are the second 5 rounds?

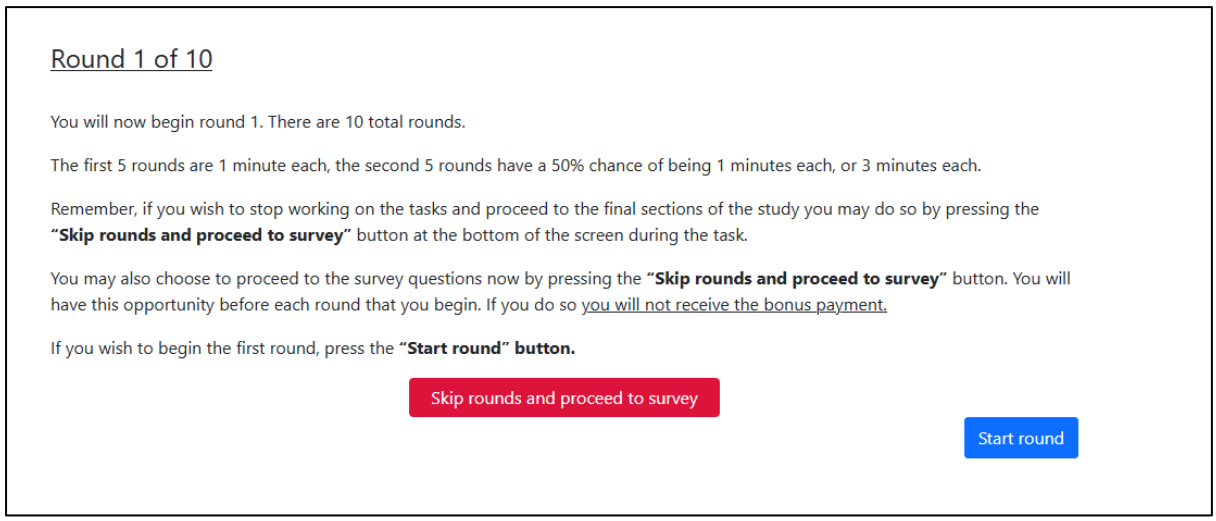
- some chance 1 minute and some chance 2 minutes
- some chance 1 minute and some chance 3 minutes
- some chance 1 minute and some chance 4 minutes
- some chance 1 minute and some chance 5 minutes

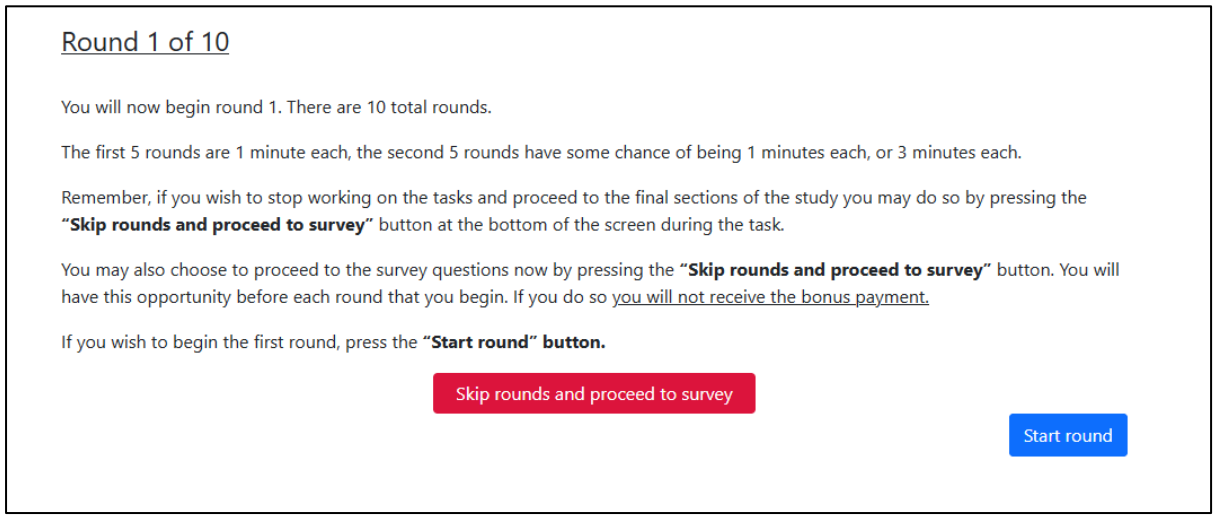
When can you choose to stop working on the task rounds?

- At any point.
- After completing the round you are working on.
- At the end of the study.

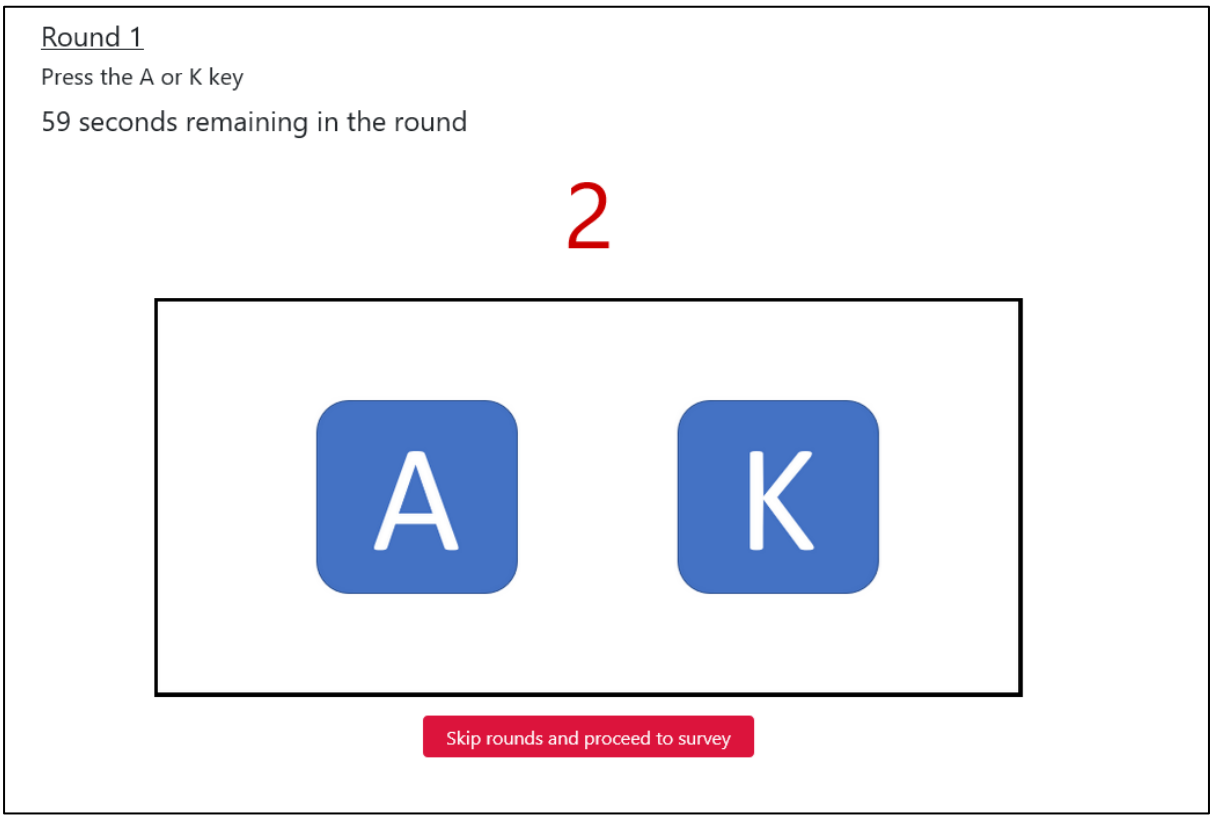
Next

Round 1 start screens for risk and ambiguity treatments respectively



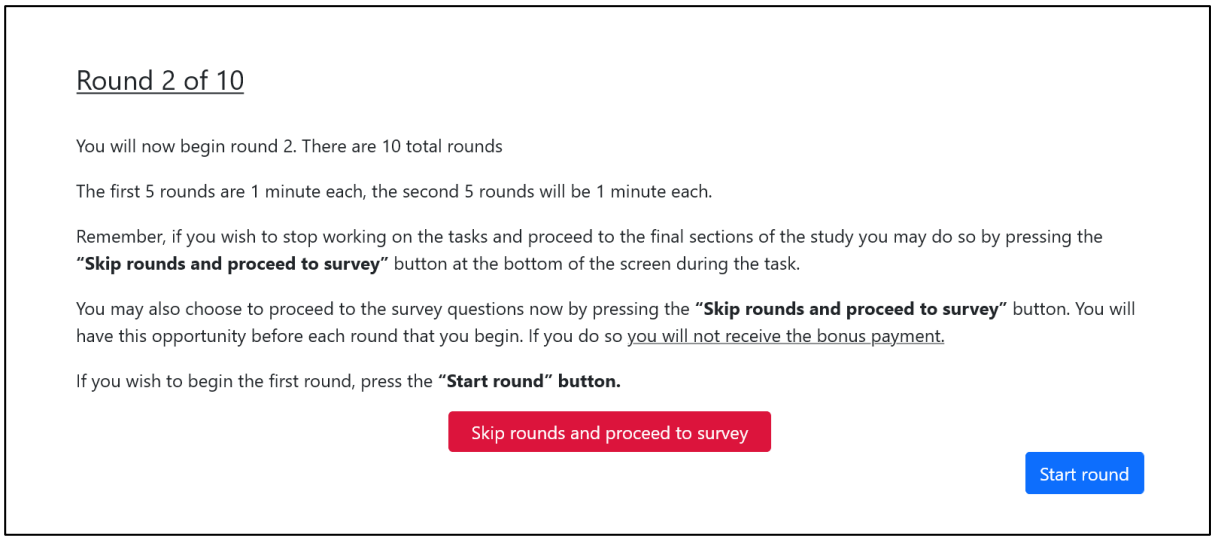


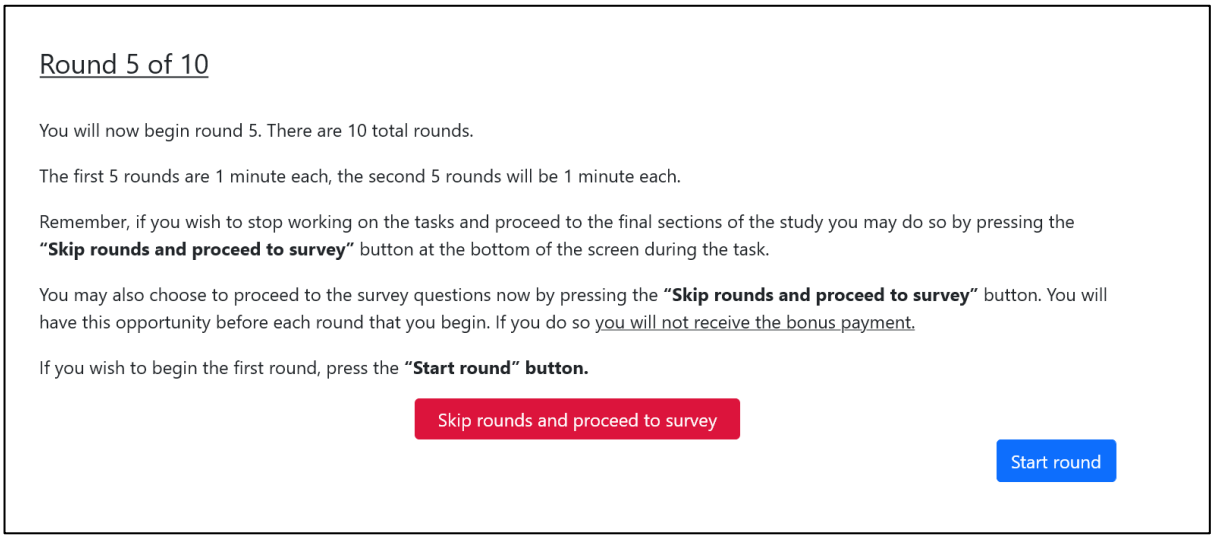
Round 1 task screen example

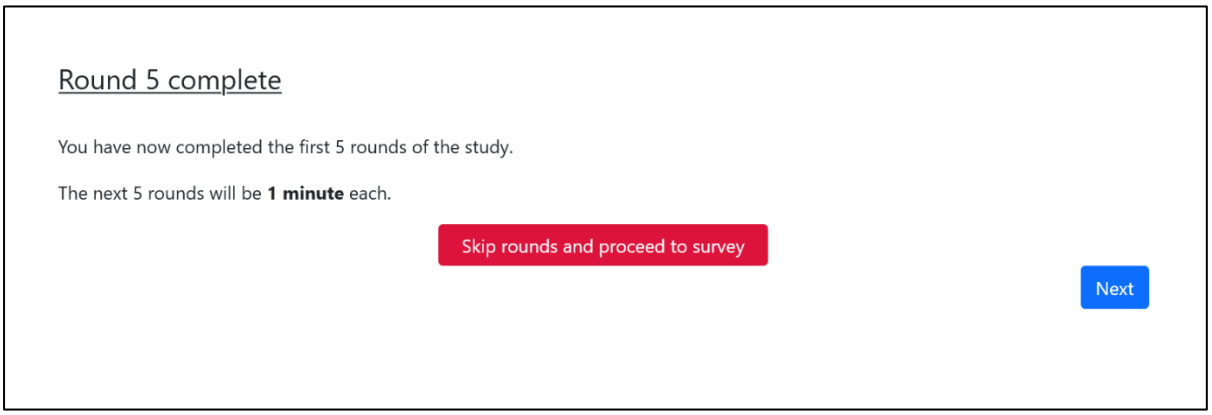


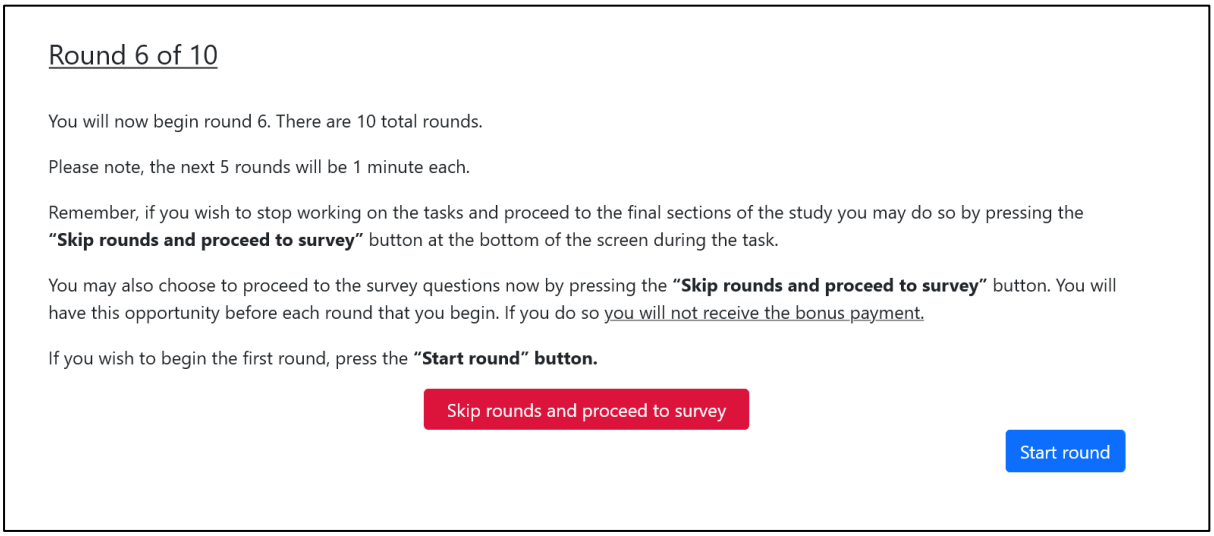
Examples of start screens for rounds 2, 5, 5 after completion and 6.

(As the start screens are similar for each treatment between rounds for visual only the screens for the full information treatment are included.)

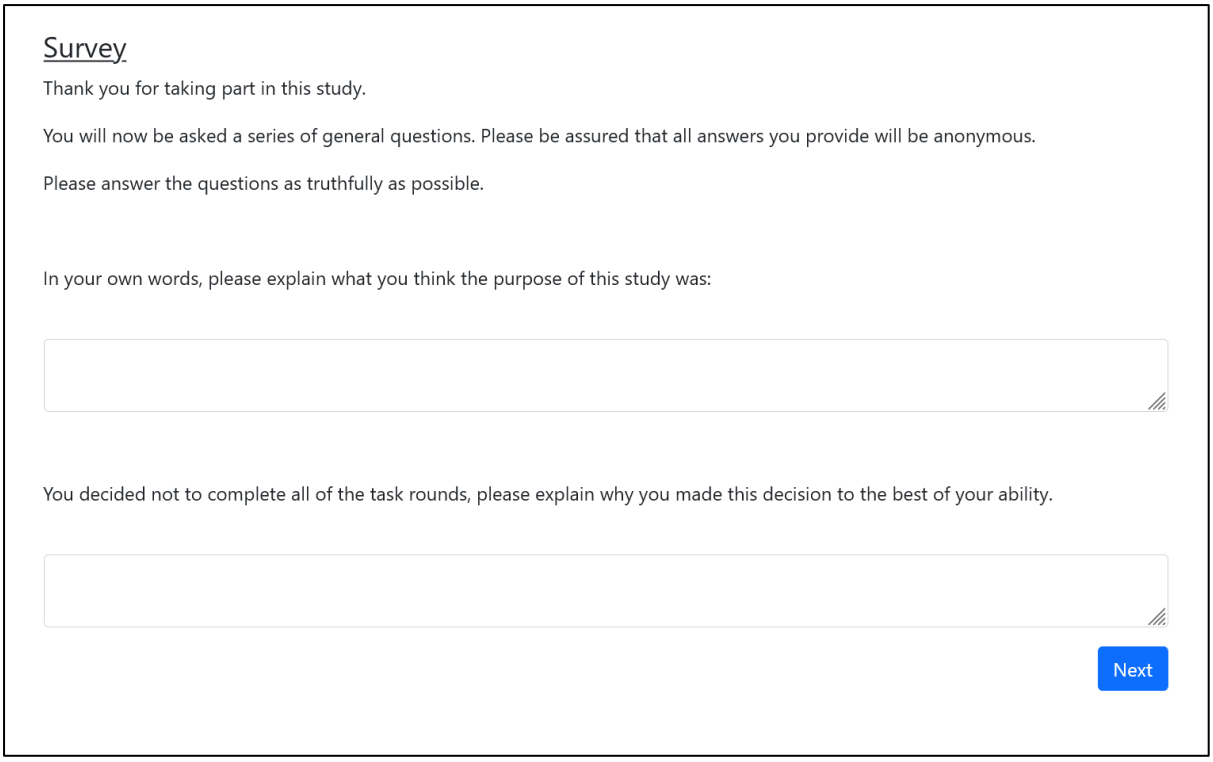


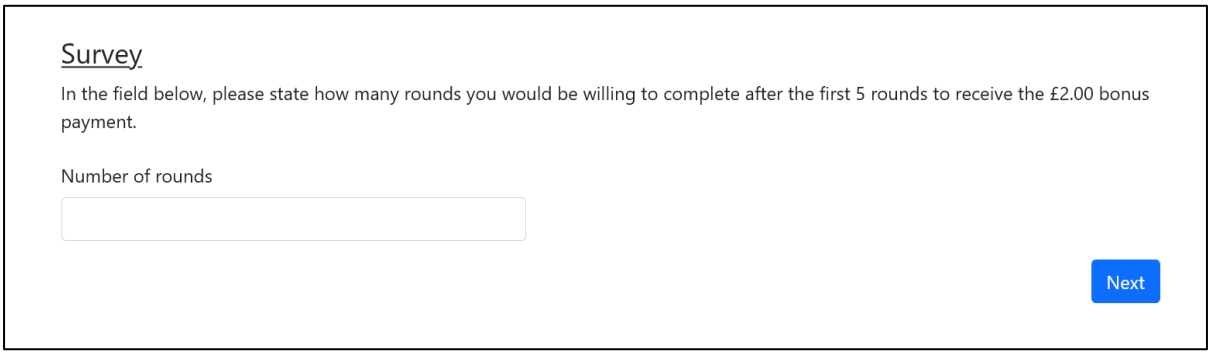


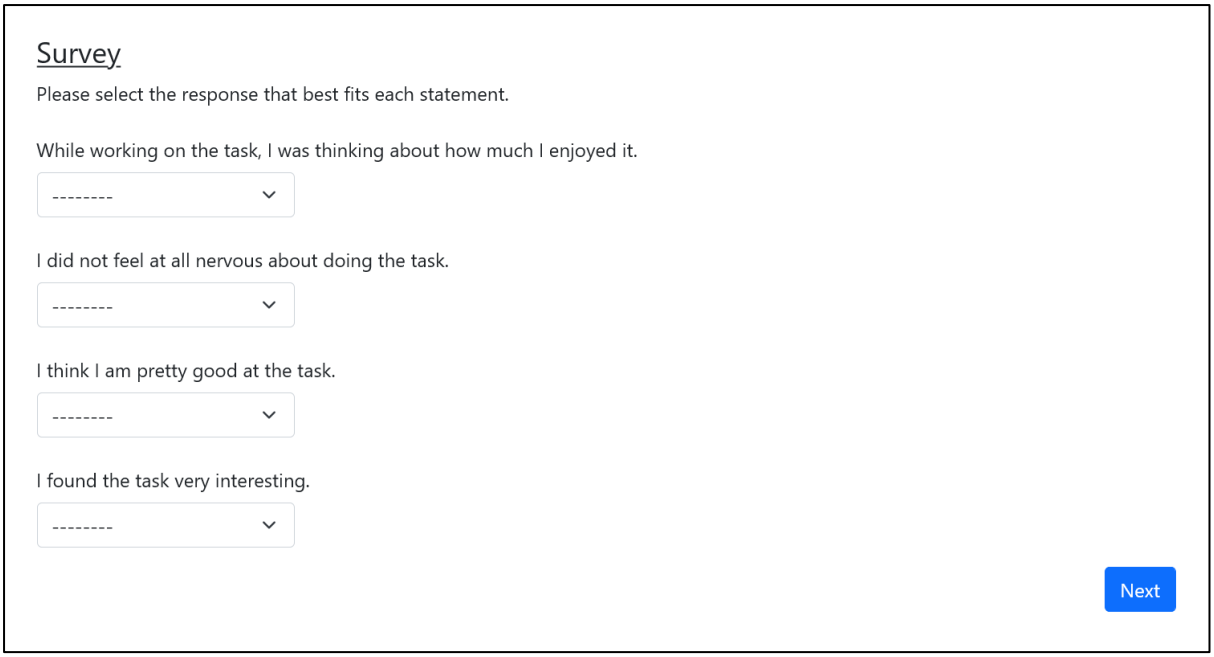

Round 5 complete
You have now completed the first 5 rounds of the study.
The next 5 rounds will be **1 minute** each.
Skip rounds and proceed to survey
Next


Round 6 of 10
You will now begin round 6. There are 10 total rounds.
Please note, the next 5 rounds will be 1 minute each.
Remember, if you wish to stop working on the tasks and proceed to the final sections of the study you may do so by pressing the **"Skip rounds and proceed to survey"** button at the bottom of the screen during the task.
You may also choose to proceed to the survey questions now by pressing the **"Skip rounds and proceed to survey"** button. You will have this opportunity before each round that you begin. If you do so you will not receive the bonus payment.
If you wish to begin the first round, press the **"Start round" button.**
Skip rounds and proceed to survey
Start round

Survey pages





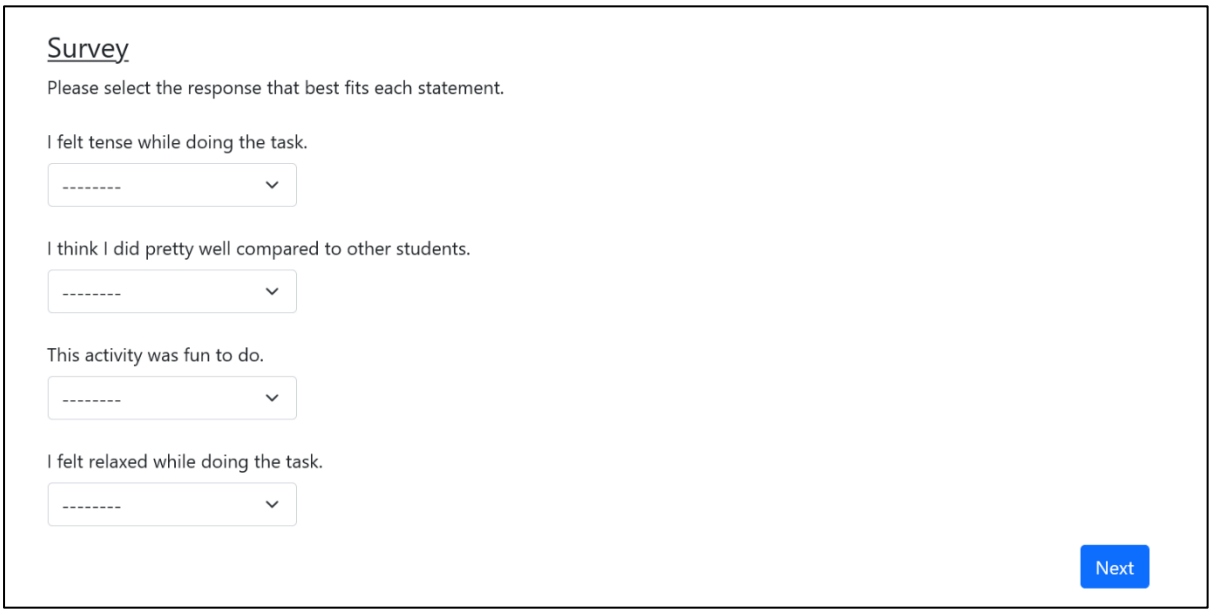

Survey
Please select the response that best fits each statement.
While working on the task, I was thinking about how much I enjoyed it.

I did not feel at all nervous about doing the task.

I think I am pretty good at the task.

I found the task very interesting.

Next

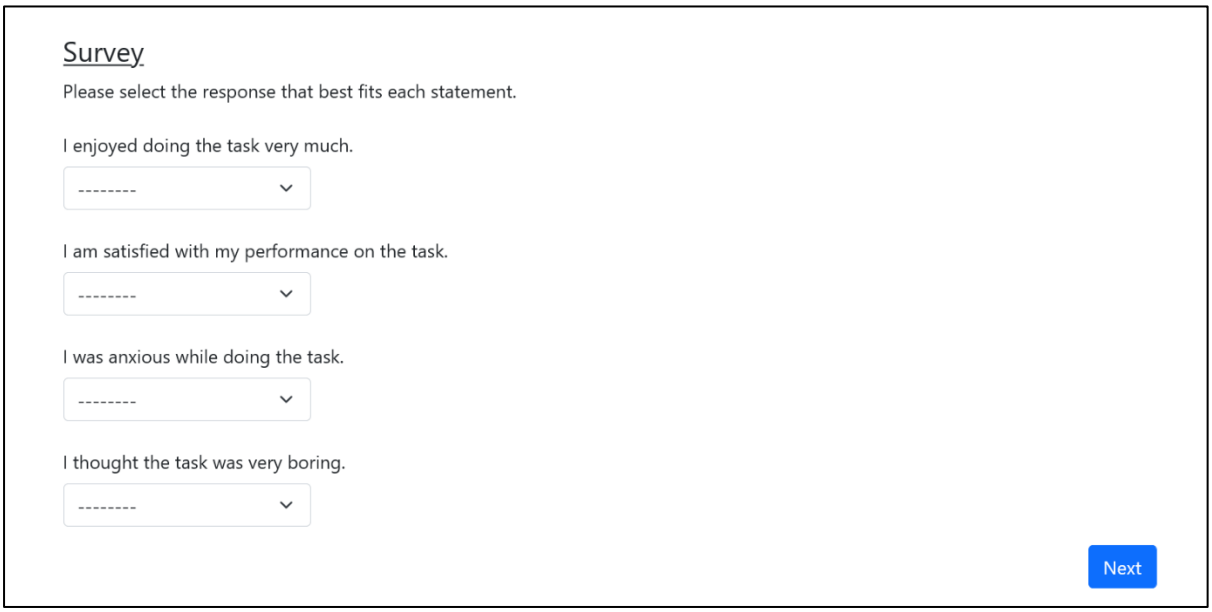

Survey
Please select the response that best fits each statement.
I felt tense while doing the task.

I think I did pretty well compared to other students.

This activity was fun to do.

I felt relaxed while doing the task.

Next


Survey
Please select the response that best fits each statement.
I enjoyed doing the task very much.

I am satisfied with my performance on the task.

I was anxious while doing the task.

I thought the task was very boring.

Next


Survey
Please select the response that best fits each statement.
I felt pretty skilled at the task.

I thought the task was very interesting.

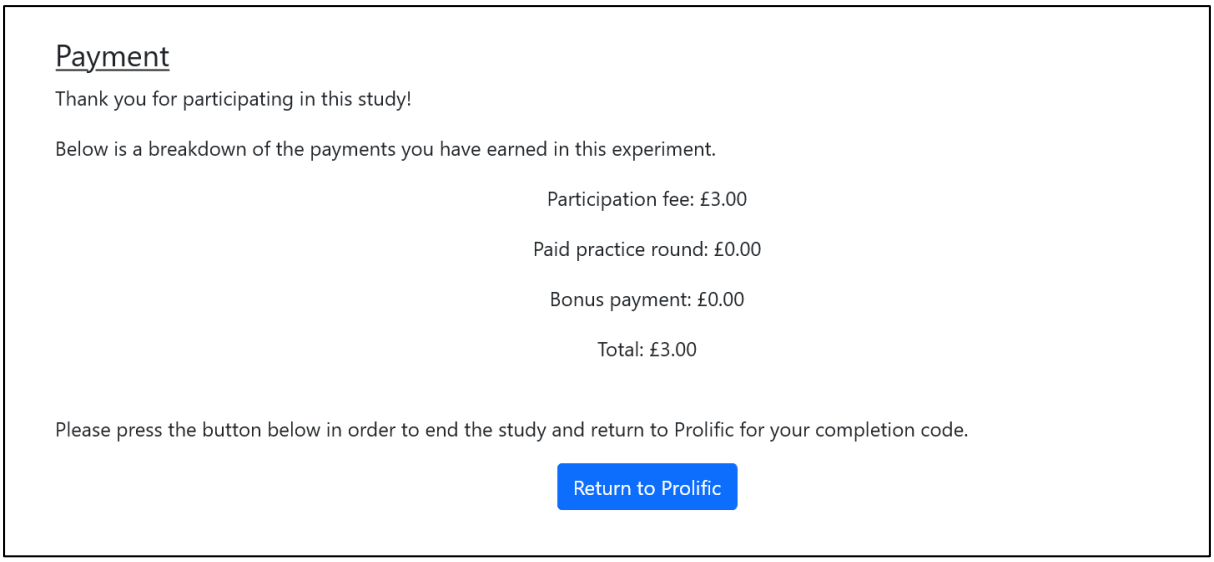
I felt pressured while doing the task.

I would describe the task as very enjoyable.

After working on this task for a while, I felt pretty competent.

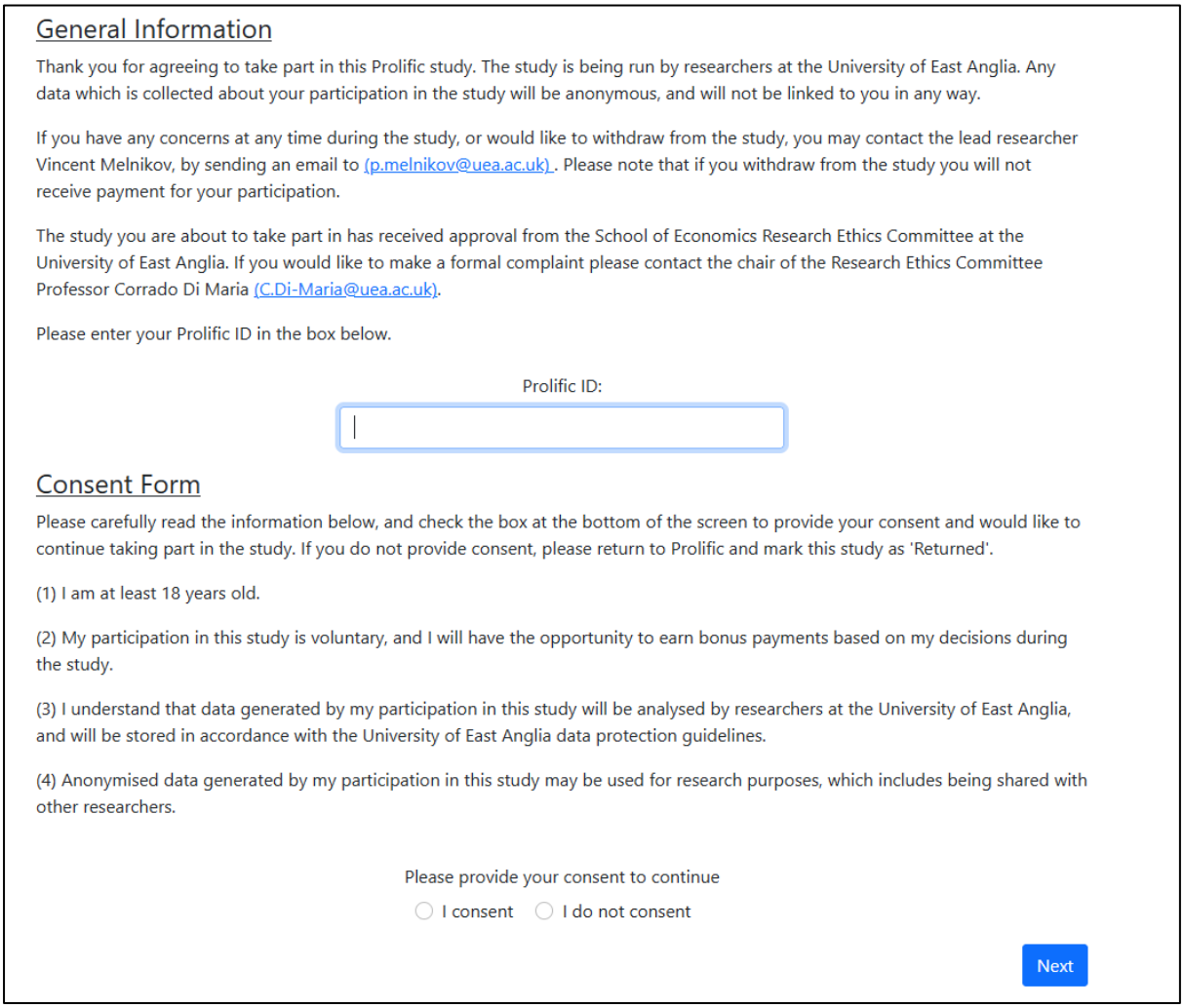
Next

Payment screen



Annex 5 – Experiment 2 Screenshots

Consent page



General Information

Thank you for agreeing to take part in this Prolific study. The study is being run by researchers at the University of East Anglia. Any data which is collected about your participation in the study will be anonymous, and will not be linked to you in any way.

If you have any concerns at any time during the study, or would like to withdraw from the study, you may contact the lead researcher Vincent Melnikov, by sending an email to (p.melnikov@uea.ac.uk) . Please note that if you withdraw from the study you will not receive payment for your participation.

The study you are about to take part in has received approval from the School of Economics Research Ethics Committee at the University of East Anglia. If you would like to make a formal complaint please contact the chair of the Research Ethics Committee Professor Corrado Di Maria (C.Di-Maria@uea.ac.uk).

Please enter your Prolific ID in the box below.

Prolific ID:

Consent Form

Please carefully read the information below, and check the box at the bottom of the screen to provide your consent and would like to continue taking part in the study. If you do not provide consent, please return to Prolific and mark this study as 'Returned'.

(1) I am at least 18 years old.

(2) My participation in this study is voluntary, and I will have the opportunity to earn bonus payments based on my decisions during the study.

(3) I understand that data generated by my participation in this study will be analysed by researchers at the University of East Anglia, and will be stored in accordance with the University of East Anglia data protection guidelines.

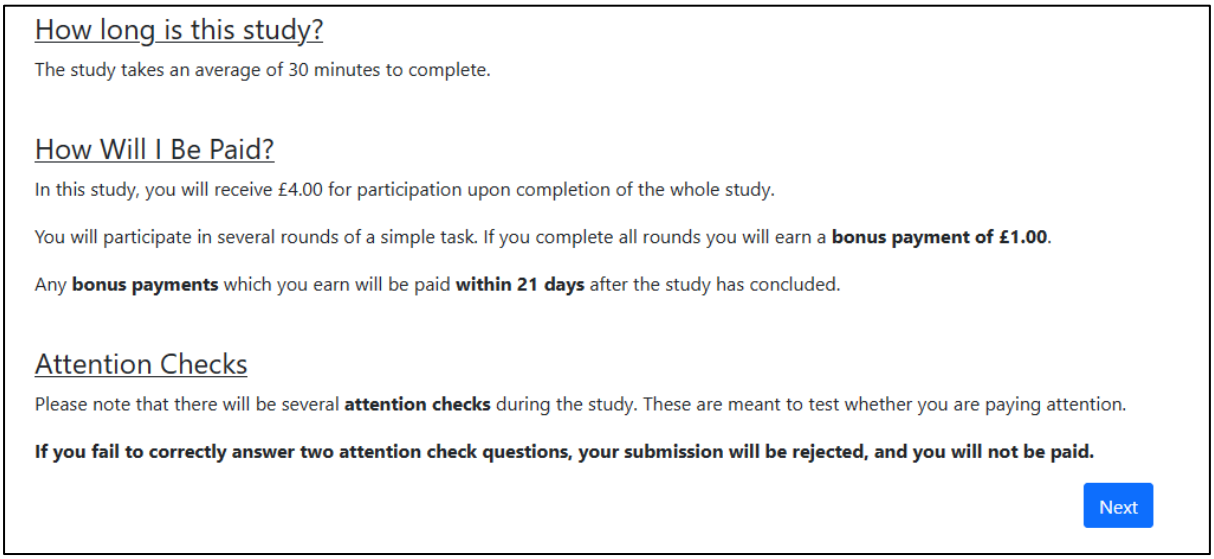
(4) Anonymised data generated by my participation in this study may be used for research purposes, which includes being shared with other researchers.

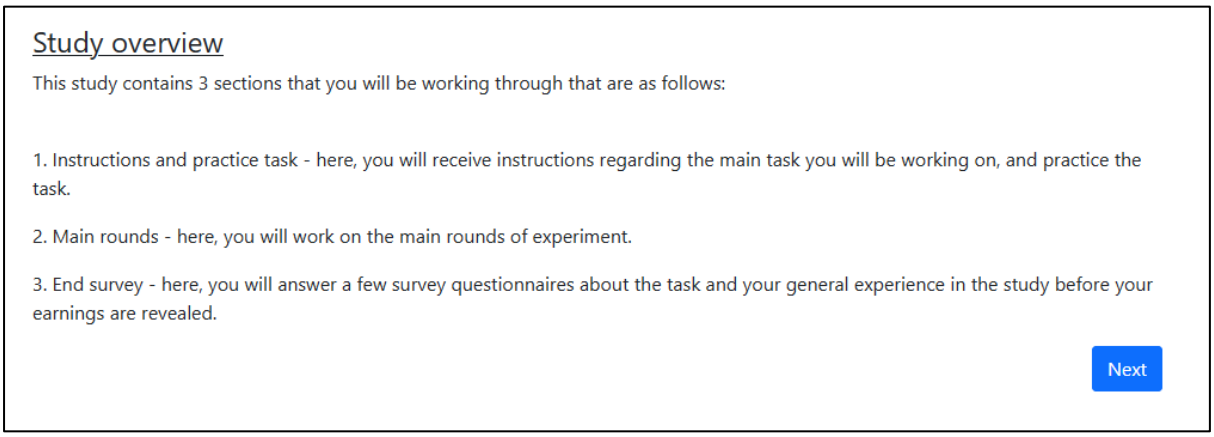
Please provide your consent to continue

I consent I do not consent

Next

Study overview pages





Task instructions page

Key-press task

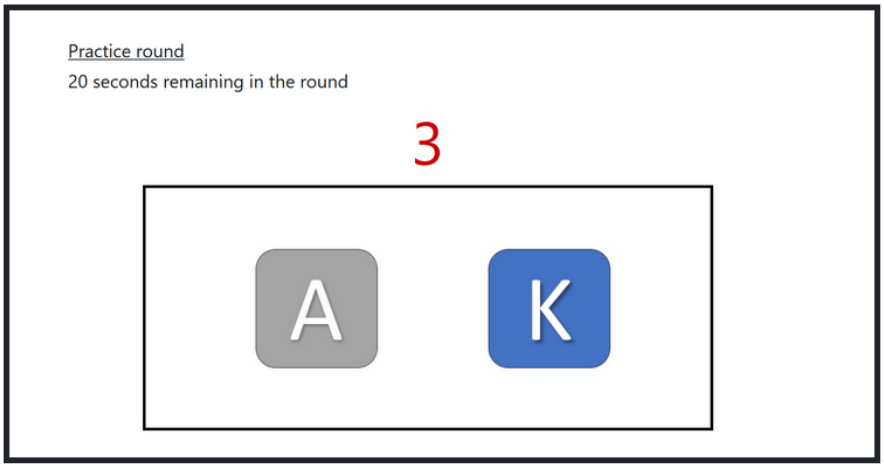
During this study, you will be engaging in several rounds of a simple key-pressing task. The objective of the task is to alternately press the 'a' and 'k' keys on your keyboard (i.e., first you press 'a', then 'k', then 'a', and so on).

You must continuously alternate between pressing the two keys for the duration of the task. **No more than 3 seconds** can elapse between pressing the keys.

A timer will be shown on the screen counting down from 3 to 0, and it will refresh each time you press the correct key. You must therefore enter the correct key before the countdown reaches 0.

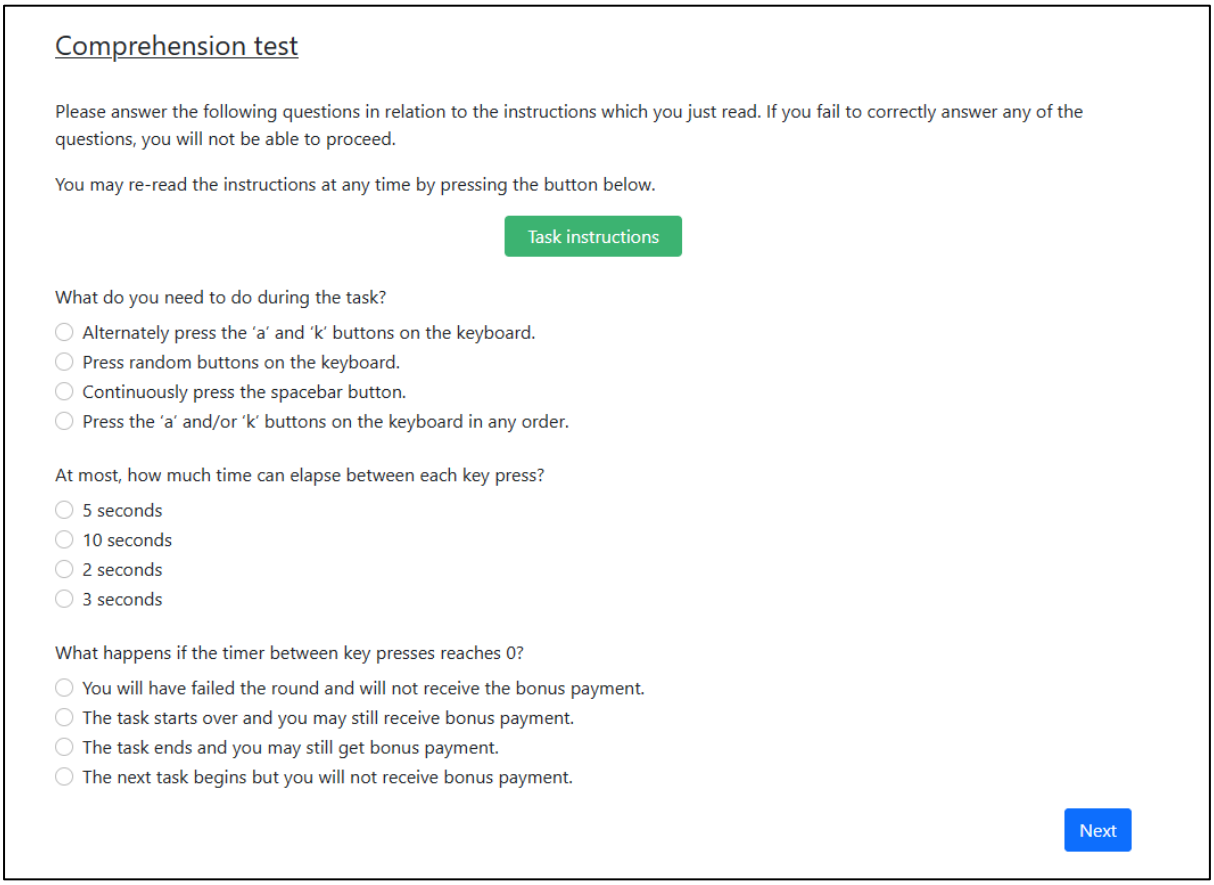
If the timer reaches 0 before you press the next key, the task will automatically end, and you will move on to the final section of the study. You will not be able to work on any of the subsequent rounds and **you will not receive the £1.00 bonus payment**. You will receive the participation payment.

Below is an example for the task:



Next

Task comprehension test page



Practice task pages

Practise the task

Before we continue with the instructions, you will have the opportunity to practise the task for 30 seconds.

Please note that your performance during this round **will not affect your payment for the study**. The purpose of the practice round is for you to have an opportunity to become familiar with the task.

If you would like a reminder of the instructions for the task, press the button below.

Task instructions

During this practice session you will not be penalised for the 3-second timer running out, meaning that the task will continue even if the timer reaches 0. However, you will be notified when you have not pressed the appropriate key in the time required.

Once you begin the practice task, you will not be able to pause it. Please make sure that you are ready to take part in the practice task before you begin.

Please click on the next button to start the practice task.

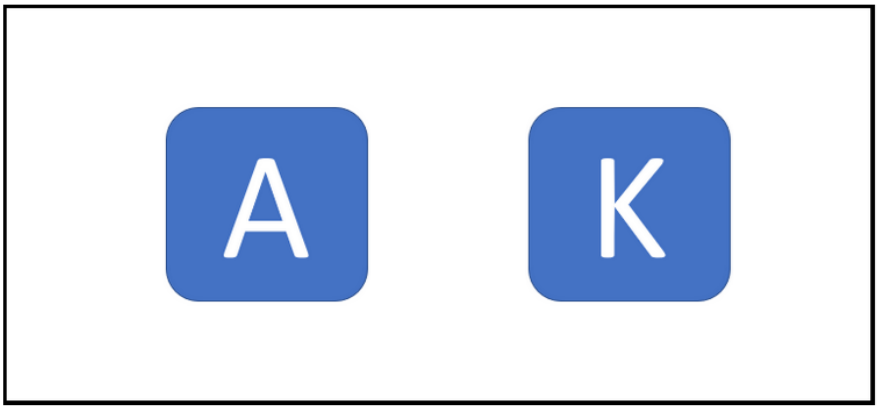
Next

Practice round

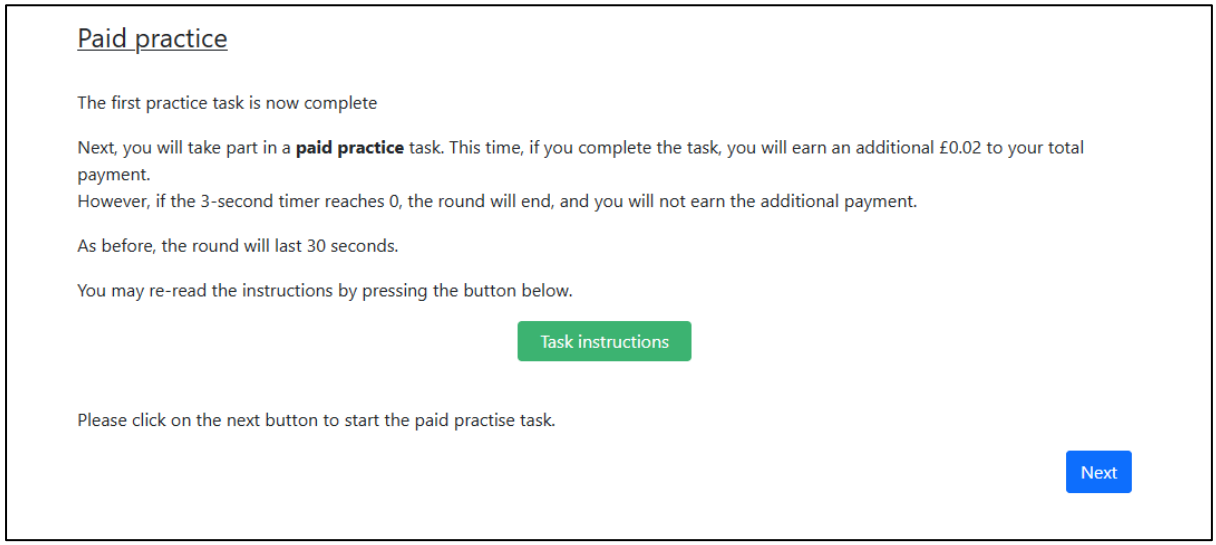
Press the A or K key

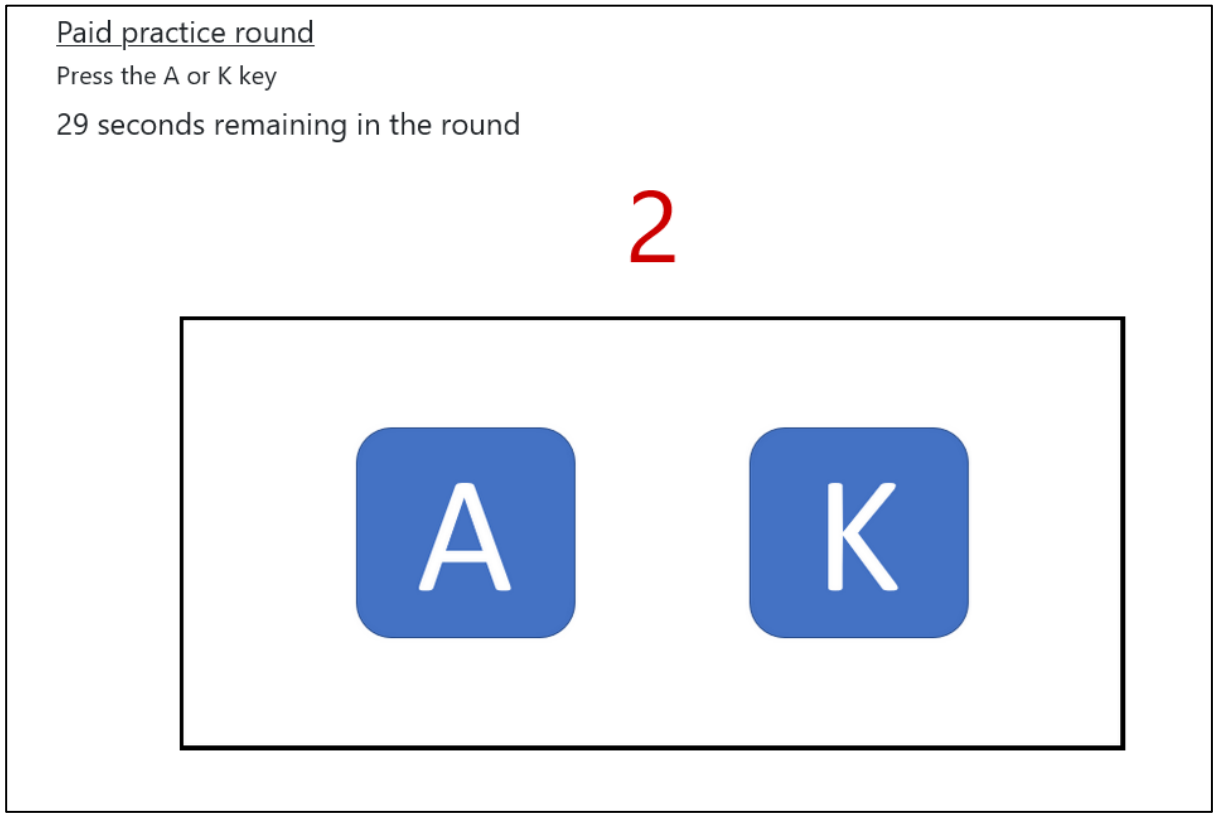
29 seconds remaining in the round

2



Paid practice task pages





Risk treatment general in structions

General instructions

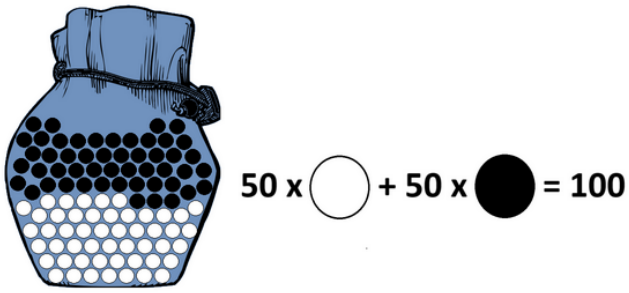
During the following part of the study, you will participate in 10 rounds of the key-press task, split into two sections of 5 rounds.

During the **first 5 rounds**, each round of the task will be **2 minutes** each.

During the **second 5 rounds** the length of the rounds will be determined by a random draw, represented below by a bag of marbles containing 100 marbles, **50 white and 50 black marbles**.

If a white marble is drawn, the second 5 rounds will be 2 minutes each as previously. If a black marble is drawn, the second 5 rounds will be 40 seconds each.

This means that there is a **50% chance** that the second 5 rounds will be **2 minutes each**, and a **50% chance** that the second 5 rounds will be **40 seconds each**.



Next

Bonus payment

In order to complete this study **and receive the £1.00 bonus payment** in addition to your participation payment of £4.00, you will need to complete **all 10 rounds** and complete a few short survey questions about the task at the end of the study.

While you are working on the tasks, there will be a button that will allow you to stop working and skip to the survey questions. You may stop working on the task rounds at any time if you wish. If you do so, **you will receive the participation payment upon completion of the final sections, but you will not receive the bonus payment**.

Next

Comprehension test

Please answer the following questions, related to the instructions which you have just read. If you fail to correctly answer any of the questions, you will not be able to proceed.

You may re-read the instructions at any time by pressing the button below.

General instructions

How many rounds do you need to complete to receive the bonus payment?

- 5
- 1
- 10
- 20

How long are the first 5 rounds?

- 4 minutes
- 1 minute
- 3 minutes
- 2 minutes

How long are the second 5 rounds?

- 50% chance 3 minutes and 50% chance 30 seconds
- 50% chance 2 minutes and 50% chance 40 seconds
- 50% chance 3 minutes and 50% chance 40 seconds
- 50% chance 2 minutes and 50% chance 30 seconds

When can you choose to stop working on the task rounds?

- At any point.
- After completing the round you are working on.
- At the end of the study.

Next

Ambiguity treatment instructions

General instructions

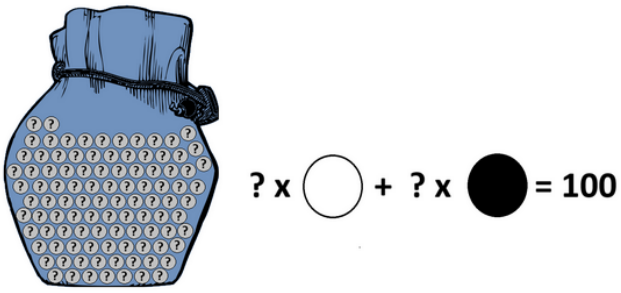
During the following part of the study, you will participate in 10 rounds of the key-press task, split into two sections of 5 rounds.

During the **first 5 rounds**, each round of the task will be **2 minutes** each.

During the **second 5 rounds** the length of the rounds will be determined by a random draw, represented below by a bag of marbles containing 100 marbles, **some white and some black**.

If a white marble is drawn, the second 5 rounds will be 2 minutes each as previously. If a black marble is drawn, the second 5 rounds will be 40 seconds each.

This means that there is **some chance** that the second 5 rounds will be **2 minutes each**, and **some chance** that the second 5 rounds will be **40 seconds each**.



Next

Bonus payment

In order to complete this study **and receive the £1.00 bonus payment** in addition to your participation payment of £4.00, you will need to complete **all 10 rounds** and complete a few short survey questions about the task at the end of the study.

While you are working on the tasks, there will be a button that will allow you to stop working and skip to the survey questions. You may stop working on the task rounds at any time if you wish. If you do so, **you will receive the participation payment upon completion of the final sections, but you will not receive the bonus payment**.

Next

Comprehension test

Please answer the following questions, related to the instructions which you have just read. If you fail to correctly answer any of the questions, you will not be able to proceed.

You may re-read the instructions at any time by pressing the button below.

General instructions

How many rounds do you need to complete to receive the bonus payment?

- 5
- 1
- 10
- 20

How long are the first 5 rounds?

- 4 minutes
- 1 minute
- 3 minutes
- 2 minutes

How long are the second 5 rounds?

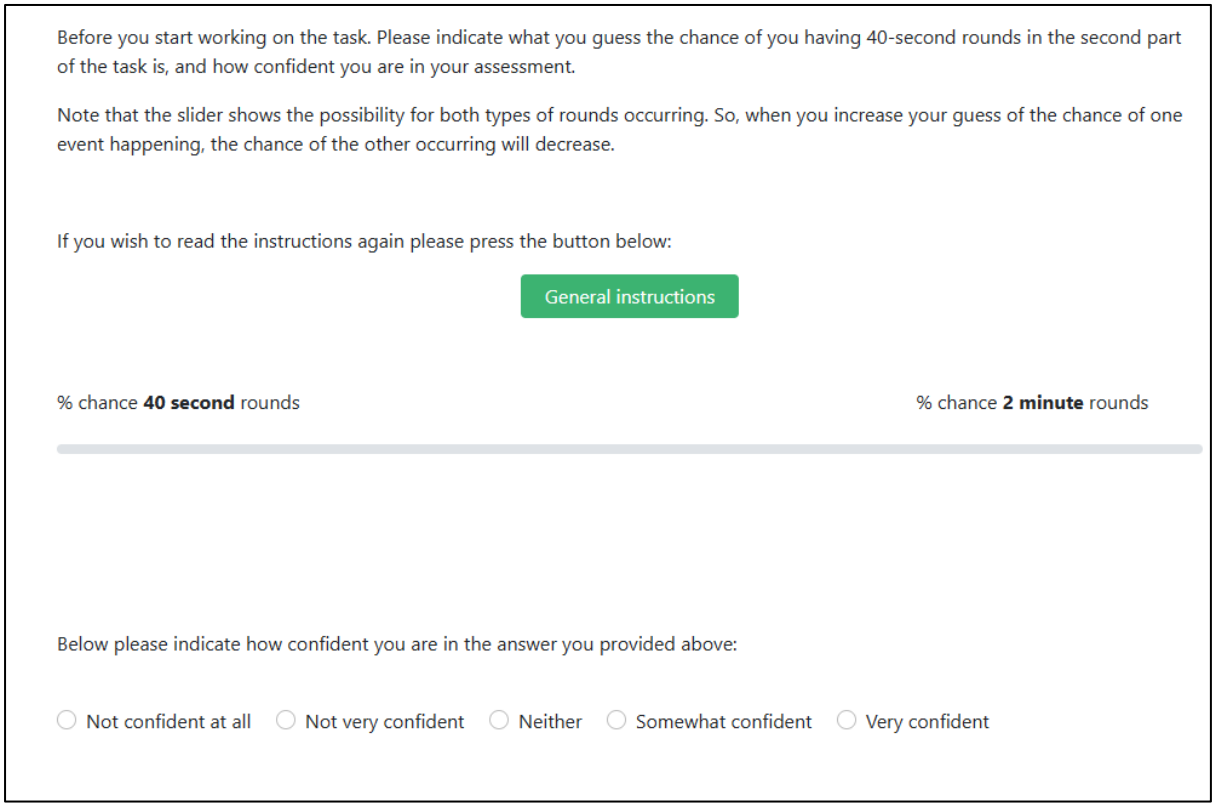
- some chance 3 minutes and some chance 30 seconds
- some chance 2 minutes and some chance 40 seconds
- some chance 3 minutes and some chance 40 seconds
- some chance 2 minutes and some chance 30 seconds

When can you choose to stop working on the task rounds?

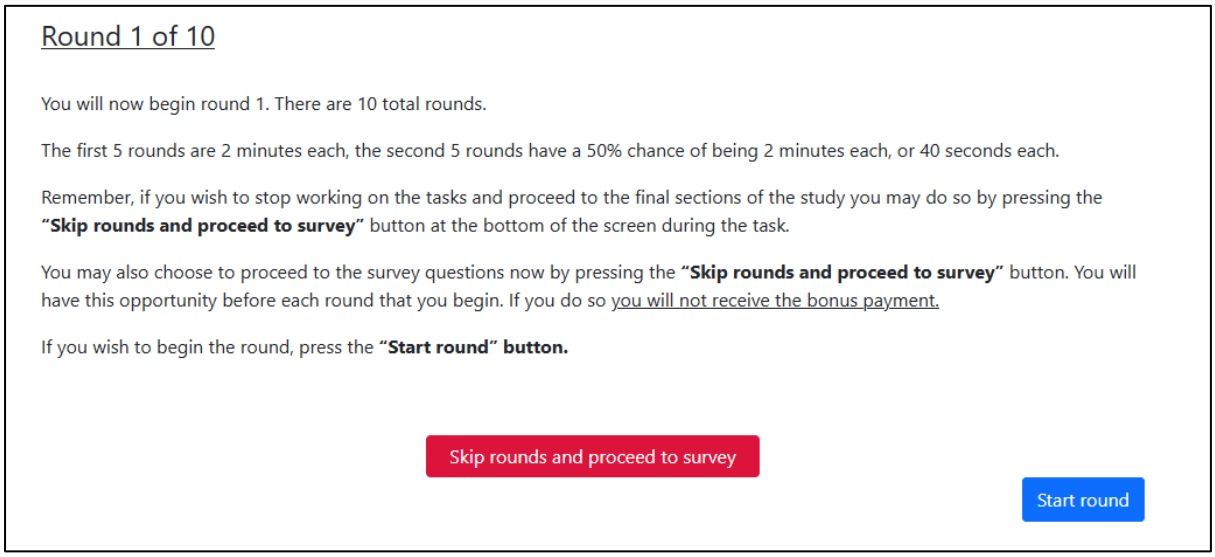
- At any point.
- After completing the round you are working on.
- At the end of the study.

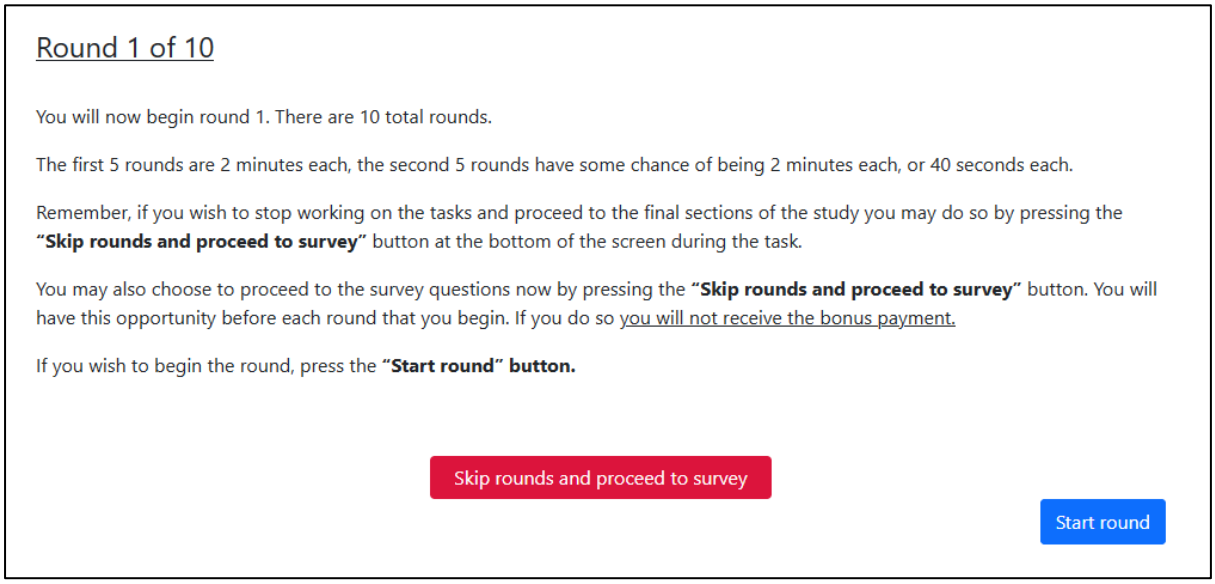
Next

Belief elicitation task

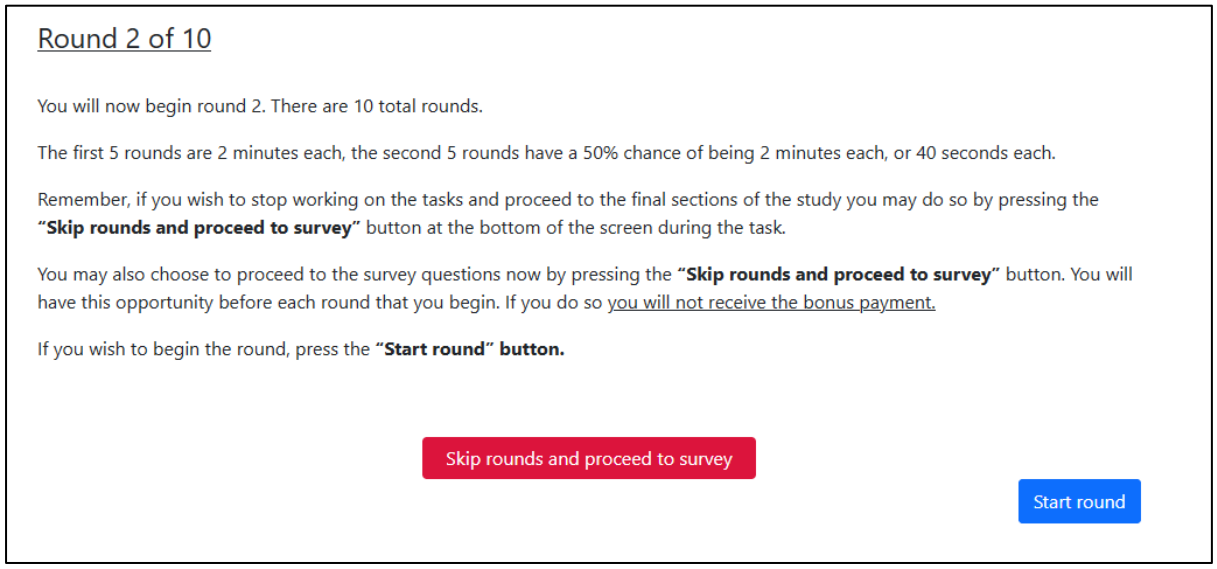


Round 1 start screen for the risk and ambiguity treatments respectively

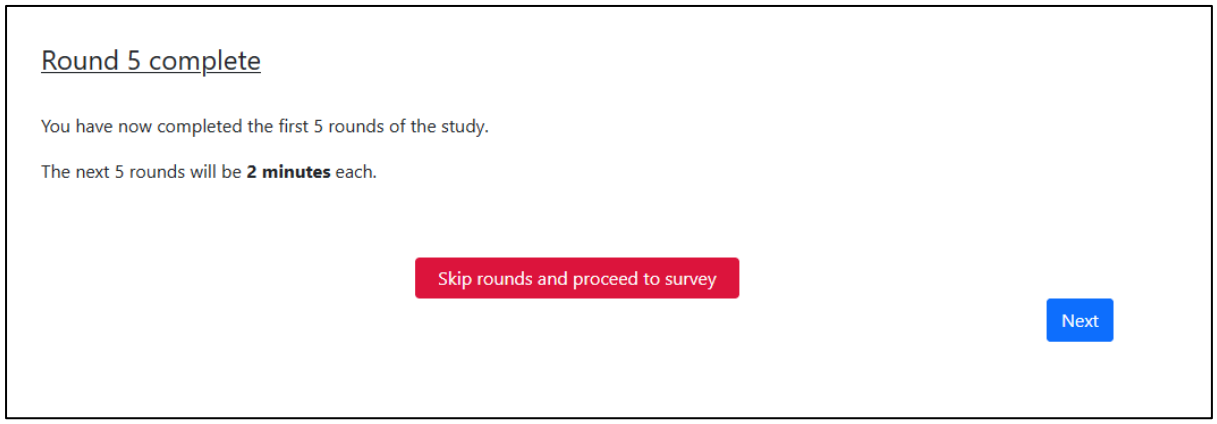




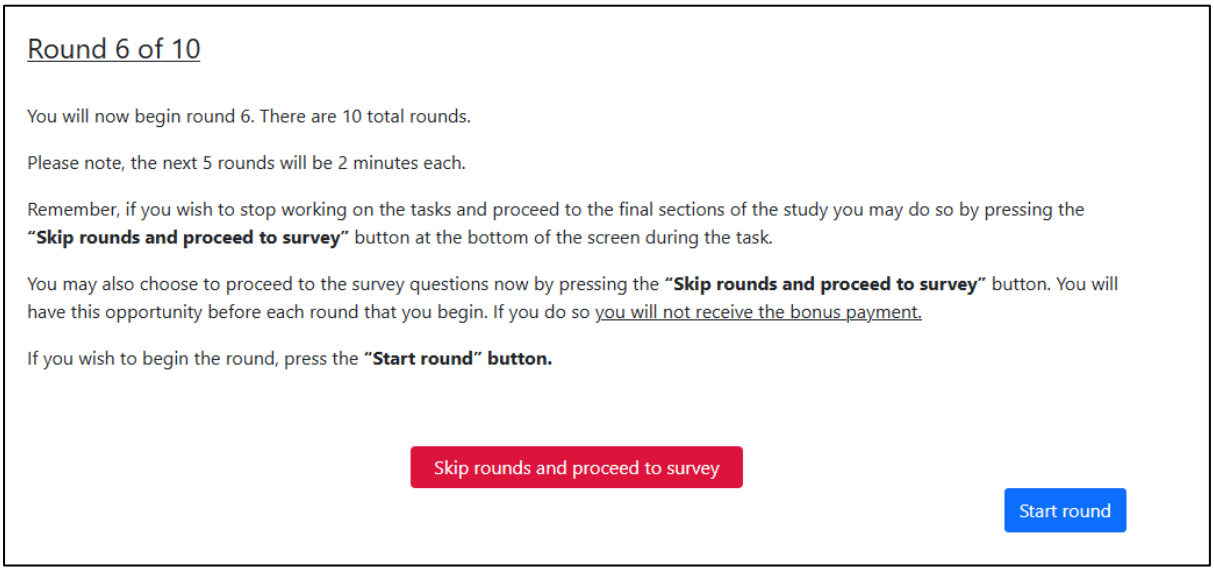
Round 2 start screen



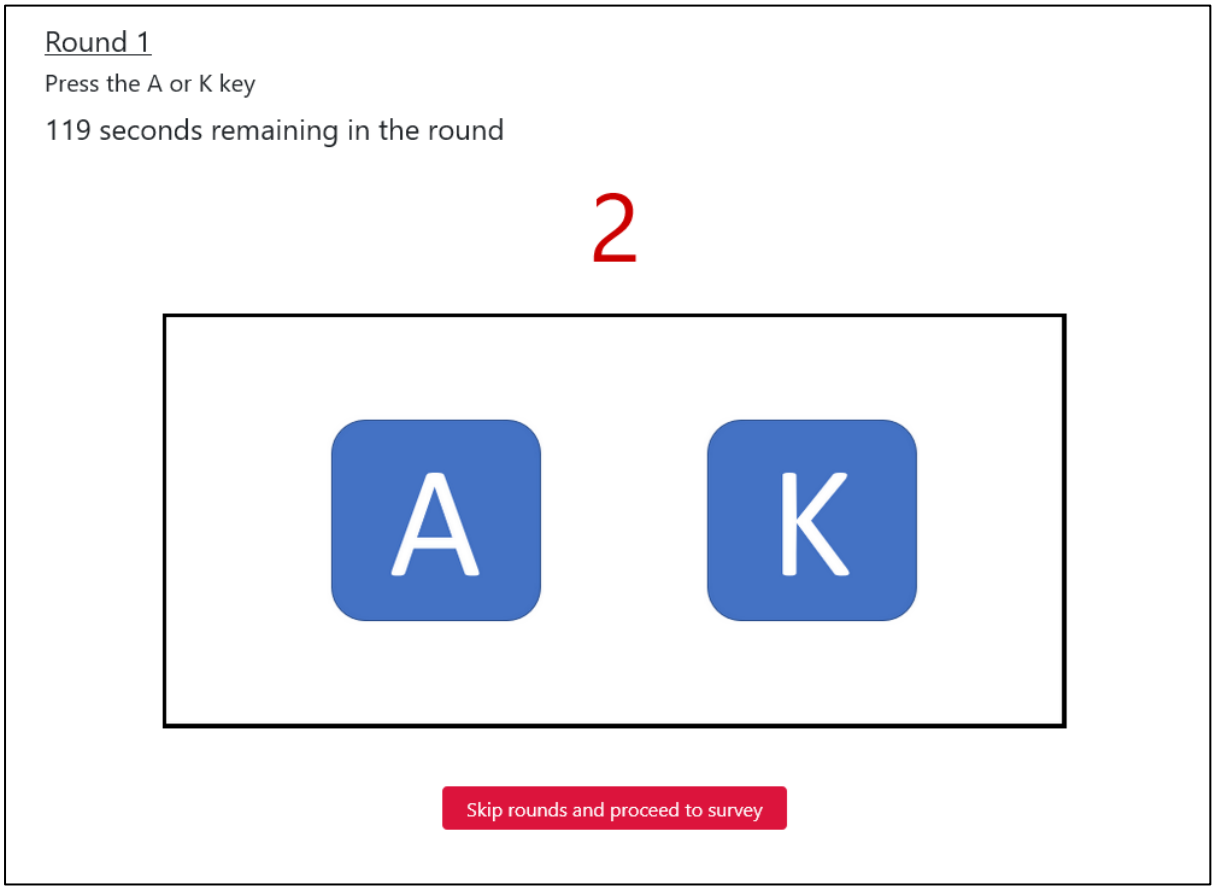
Round 5 completion screen



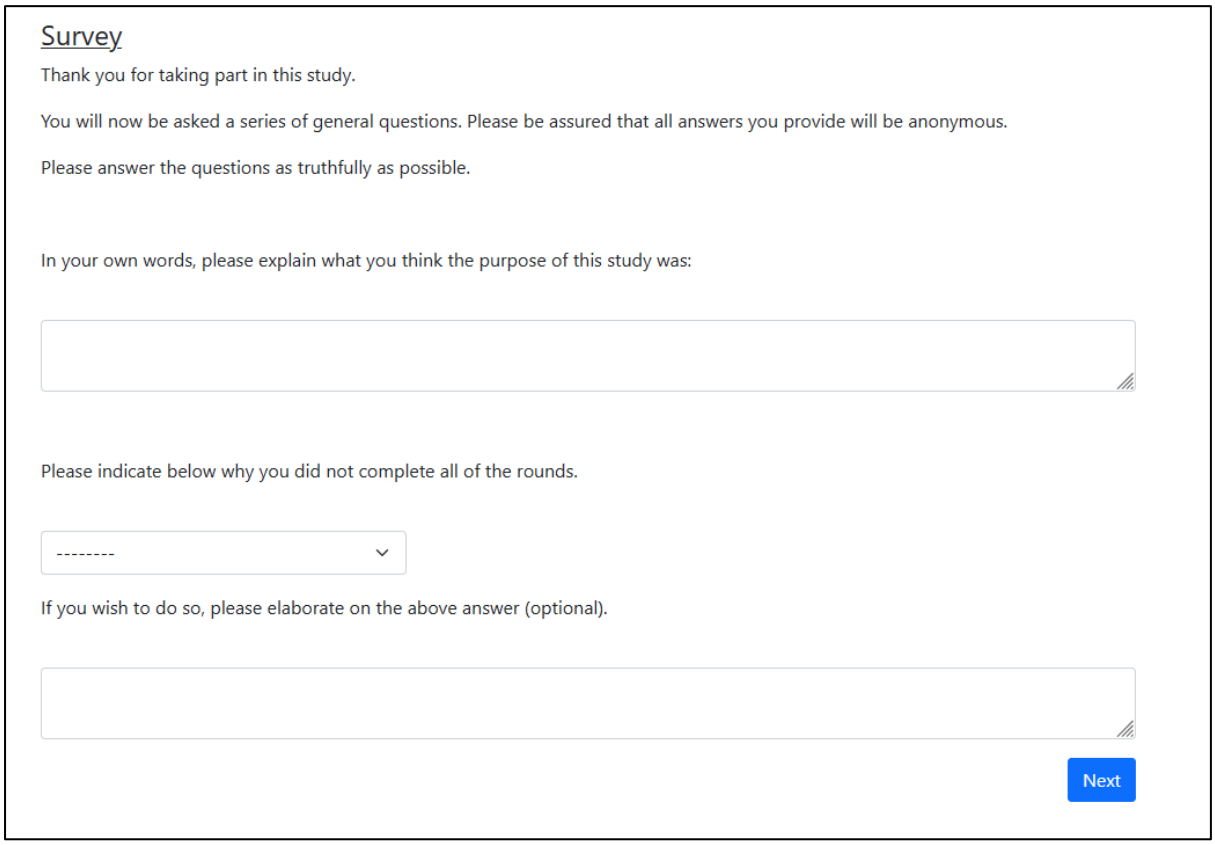
Round 6 start screen

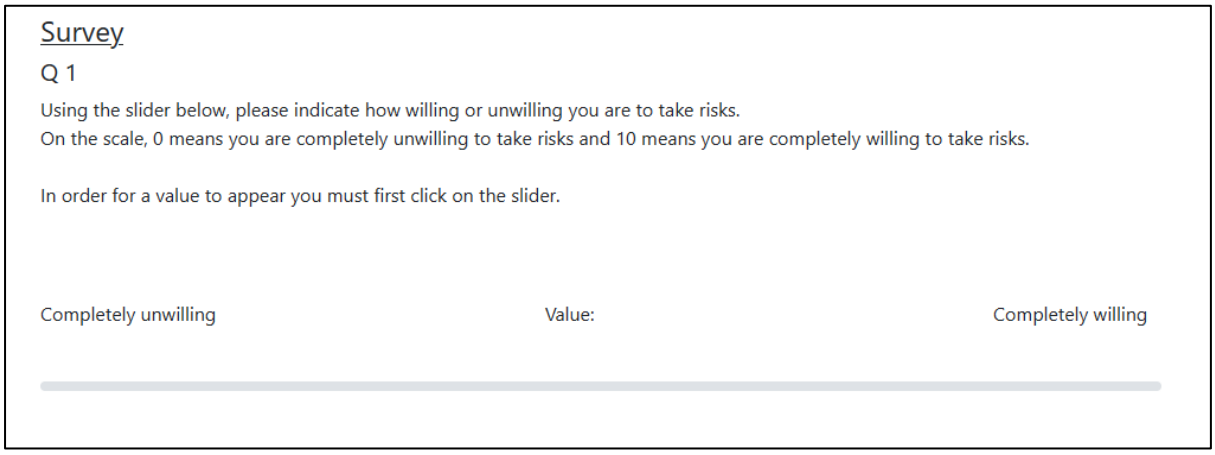


Round task screen page



Survey pages





Survey

Q 2

In a hypothetical lottery which would you prefer:
a draw with a 50 percent chance of receiving £300, and a 50 percent chance of receiving nothing,
or the amount of £160 as a sure payment?

- ○ 50% chance of £300 and a 50% chance of £0
- ○ Sure payment of £160

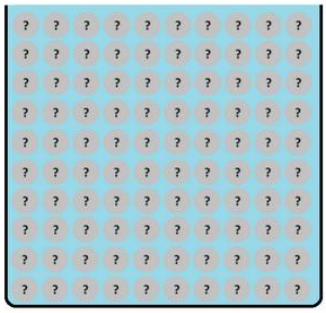
Next

Survey

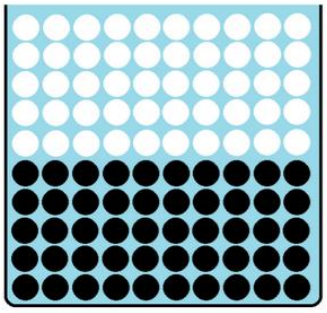
Please consider the following hypothetical scenario:

You can choose to draw a marble from two one of two different urns (A and B).

Urn **A** contains 100 marbles. Each marble is either black or white. The number of each coloured marble in the urn is **unknown**.



Urn **B** contains 100 marbles. There are exactly **50 black** marbles and **50 white** marbles in this urn.



First, you may choose your preferred colour of marble.

Suppose that if you draw your chosen coloured marble, you would win £10 (this is hypothetical).

Which of the two urns would you rather draw a marble from?

○	○	○	○	○
Strong preference to draw from urn **A**	**Slight** preference to draw from urn **A**	**Indifferent** between drawing from urn A or from urn B	**Slight** preference to draw from urn **B**	**Strong** preference to draw from urn **B**

Next

Survey

Please select the response that best fits each statement.

	Not like me at all	Not much like me	Somewhat like me	Mostly like me	Very much like me
New ideas and projects sometimes distract me from previous ones.	○	○	○	○	○
Setbacks don't discourage me.	○	○	○	○	○
I have been obsessed with a certain idea or project for a short time but later lost interest.	○	○	○	○	○
I am a hard worker.	○	○	○	○	○
I often set a goal but later choose to pursue a different one.	○	○	○	○	○
I have difficulty maintaining my focus on projects that take more than a few months to complete.	○	○	○	○	○
I finish whatever I begin.	○	○	○	○	○
I am diligent.	○	○	○	○	○

Next

Survey

Please select the response that best fits each statement.

	Not true at all	Somewhat not true	Neither true nor untrue	Somewhat true	Very true
After completing the 30-second practice round, I felt I knew how longa 2-minute round would feel.	○	○	○	○	○
Once I started the first 2-minute round, it felt longer than I had expected	○	○	○	○	○
While working on the task, I was thinking about how much I enjoyed it.	○	○	○	○	○
I did not feel at all nervous about doing the task.	○	○	○	○	○
I think I am pretty good at the task.	○	○	○	○	○
I found the task very interesting.	○	○	○	○	○
I felt tense while doing the task.	○	○	○	○	○
I think I did pretty well compared to other students.	○	○	○	○	○
This activity was fun to do.	○	○	○	○	○
I felt relaxed while doing the task.	○	○	○	○	○
I enjoyed doing the task very much.	○	○	○	○	○

Next

Survey

Please select the response that best fits each statement.

	Not true at all	Somewhat not true	Neither true nor untrue	Somewhat true	Very true
I am satisfied with my performance on the task.	○	○	○	○	○
I was anxious while doing the task.	○	○	○	○	○
I thought the task was very boring.	○	○	○	○	○
I felt pretty skilled at the task.	○	○	○	○	○
I thought the task was very interesting.	○	○	○	○	○
I felt pressured while doing the task.	○	○	○	○	○
I would describe the task as very enjoyable.	○	○	○	○	○
After working on this task for a while, I felt pretty competent.	○	○	○	○	○

Next

Survey

Please answer the following demographics questions. The information is anonymous.

What is your gender?

- ○ Female
- ○ Male
- ○ Non-binary
- ○ A gender not listed
- ○ Prefer not to say

What is your age?

- ○ Under 18
- ○ 18-24
- ○ 25-34
- ○ 35-44
- ○ 45-54
- ○ Over 55
- ○ Prefer not to say

What is the highest level of education you have completed?

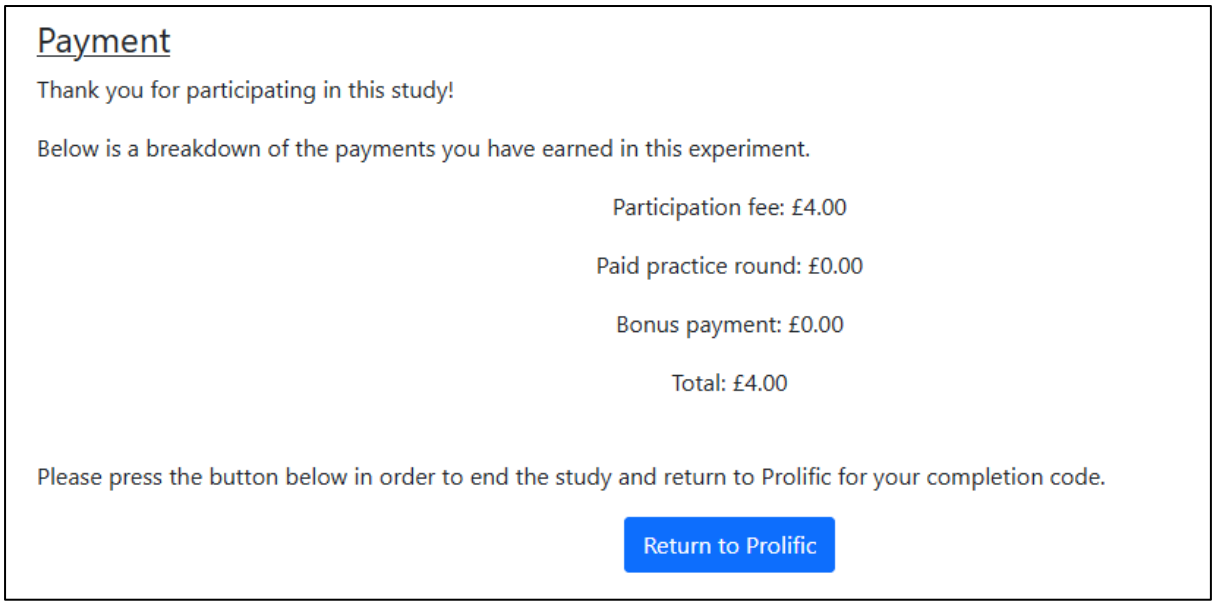
- ○ Primary school
- ○ Secondary school up to 16 years
- ○ Higher or secondary or further education (A-levels, BTEC, etc.
- ○ College or university
- ○ Post-graduate degree
- ○ Prefer not to say

What is your current employment status?

- ○ Student
- ○ Full-time
- ○ Part-time
- ○ Unemployed
- ○ Retired
- ○ Prefer not to say

Next

Payment screen



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