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Relative Risk Taking and Social Curiosity

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Abstract

We present an experiment providing (a) a horse race among different models combining social preferences and risk preferences, and (b) a test of whether agents are socially curious, that is wanting to know about the risk taking of others and the outcomes of their risk taking. We distinguish outcome driven models (that is, models where agents care about the earning outcomes for themselves and others) from action driven models (that is, models where agents care about one's risk taking actions relative to the actions of others). We embed outcome and action driven competitive preferences, inequality aversion, conformism, and social loss aversion, within a single general theoretical framework. We find that competitive preferences models best explain investment decisions in our setting, with almost 50% of subjects influenced both by their co-participants' actions and outcomes. About 90% of subjects seek social information when it is free. When it is costly, 30% of subjects seek social information if the information is instrumental for their own investment decision and about 15% seek social information even if it is not. Competitive preferences can help explain social curiosity.

JEL Classification: C91, D81, D91, G11, G22.

Keywords: Risk, curiosity, peer effects, social preferences, competitive preferences, social comparison.

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1. Introduction

A growing literature shows that agents' propensity for taking risks is socially embedded.[1] That is, it not only depends on their attitude towards risk but also on the risky behavior of others. We present an experiment where we test a range of explanations for why agents' risk taking behavior is socially embedded. Using our experimental data, we estimate a generalized version of the Bolton and Ockenfels (2000) model to run a horse race among a number of possible explanations of peer effects in risk taking, namely: (i) inequality aversion, (ii) social loss aversion, (iii) conformism, (iv) outcome driven competitive preferences (i.e., in financial outcomes) and (v) action driven competitive preferences (i.e., in how much risk to take). Our second key contribution is that we also look at whether agents want to get social information: that is, to get to know others' risky investment choices and payoffs. Put it differently, are agents *socially curious*, and, if so, why?

Many natural world examples suggest social interdependencies in risk taking, e.g., in the context of the development of different cultures of entrepreneurship (Lopera and Marchand, 2018; Cellikol et al., 2019), insurance demand (Friedl et al., 2014), stock market bubbles and crashes (Shiller, 2020), panic risk buying at the early stages of the COVID-19 pandemic (Sim et al., 2020), or face mask adoption in COVID-19 pandemic hotspots (Denworth, 2020).

As it is hard to disentangle peer effects from self-selection, or the effect of peers' attitudes on the individual from the influence of the individual on his or her peers, finding unambiguous evidence of peer effects in risk taking is often very difficult with non-experimental data (Manski, 1993). Some notable exceptions are Ahern et al. (2014), Balsa et al. (2015) and Browne et al. (2020), who, using survey data, show that peer influence on risk-taking is significant, widespread, and differs significantly based on the context and the demographic characteristics of the sample population. However, due to the inherent limitations of survey data, they are not tailored for identifying the behavioural mechanisms that underpin the observed peer effects.[2]

Economic experiments allow researchers greater control over the settings within which behaviour is studied, and several recent experimental studies have attempted to shed light on the interplay between

[1] See Boles and Messick (1995), Zizzo (2001), Bault et al. (2008), Delgado et al. (2008), Haisley et al. (2008), Hill and Buss (2010), Cooper and Rege (2011), Rohde and Rohde (2011), Viscusi et al. (2011), Linde and Sonnemans (2012), Dijk et al. (2014), Friedl et al. (2014), Kuziemko et al. (2014), Mishra et al. (2014, 2015), Fafchamps et al. (2015), Lahno and Serra-Garcia (2015), Schwerter (2015), Brookins et al. (2016), Chao et al. (2017), Gamba et al. (2017), Gioia (2017), Gantner and Kerschbamer (2018), Lopera and Marchand (2018), Gortner and van der Weele (2019), Müller and Rau (2019), Schmidt et al. (2019), Hildenbrandt and Steinorth (2020), Gill et al. (2020) and Karakostas et al. (2021).

[2] See Nakamura et al. (2017) for a more general discussion of this point, in the context of studies of peer effect studies related to unhealthy behaviors.

risk and social preferences. While all studies agree that risk-taking is socially embedded, the experimental evidence on what models are better suited at explaining how risk-taking and social preferences interact is mixed (Muller and Rau, 2019). While some studies find evidence that favours competitive preference models (e.g. Lahno and Garcia, 2015; Fafchamps et al., 2015), there is various evidence in favour of alternative models that suggest that peer effects in risk-taking may be driven by other factors, such as concerns for conformism (Cooper and Rege, 2011), inequality aversion (Muller and Rau, 2019), or last place or social loss aversion (Kuziemco et al., 2014; Schwerter, 2015). However, as each experimental study is often designed to test a specific behavioural motivation (e.g. Kuziemco et al., 2014), or, at best, contrast it with one plausible alternative (e.g. Cooper and Rege, 2011; Lahno and Serra-Garcia, 2015), drawing conclusions by comparisons across studies and models can be misguiding, as each experiment differs from the rest in several dimensions.

The key contributions of our paper are twofold. First,we employ a generalized version of the Bolton and Ockenfels (2000) model (BO in what follows) to run a horse race across a range of possible explanations of socially embedded risk taking. Our generalized BO framework has the advantages of being a single social preference parameter (thus enabling the joint estimation with the risk aversion parameter) as well as being continuously differentiable and non-linear.

To estimate the parameters of our social preference models, in our experiment we provide social information on both actions and payoffs. Furthermore, doing so allows us to provide outcome and actions driven models on equal footing in terms of salience and cognitive ease of use. Our experiment also enables additional controls (e.g., for regret, also considered by Cooper and Rege, 2011) by suitable variations on the basic risk taking task (as detailed below).

To study the social interdependence of risk-taking, we use the Gneezy and Potters (1999) risk elicitation task, where each subject needs to decide how much of their endowment they wish to allocate in an asset in which there is a 50% chance the amount they invest will be tripled and a 50% chance their investment will be lost. We opted to use the Gneezy and Potters (1999) (henceforth GP) risk elicitation task for four reasons. First, it is relatively simple for subjects to understand compared to more complex methods commonly used to elicit risk preferences in the literature, and thus less noisy (Charness et al., 2013).[3] Second, as Hillebrandt and Steinhorth (2020) note, in multiple price lists, such as the Holt and Laury (2002), the parameter choice may affect the determination of the social reference point. Third, it provides a common reference point with the experimental literature on social embedded

[3] A number of studies have shown that the multiple price list method is significantly harder to understand leading to more inconsistent choices (e.g., Dave et al., 2010; Jacobson and Petrie, 2009; Charness and Viceisza, 2011; Charness et al., 2018). For a survey of different risk elicitation methods, see Charness et al. (2013).

risk-taking, as a number of studies use the GP method when examining social risk-taking (Zizzo, 2001; Fafchamps et al., 2015; Hillebrandt and Steinhorth, 2020; Karakostas et al., 2021).[4] Fourth, and perhaps most importantly for our study, the GP method allows the calculation of point estimates for our risk aversion and social parameter coefficients, which in turn helps us compute structural estimates for our competing social preference models.

The second key contribution of this paper is to look at whether agents are *socially curious* in the context of risk taking, and get a better understanding of why this is the case. We define curiosity as the *desire to acquire information*, in our case about others' risky investment actions and outcomes. Traditional economic analysis assumes that the value of information stems solely from its role in allowing individuals to make better decisions. Thus, curiosity is always strategic or *instrumental*. However, if we model risk taking actions or outcomes of others in the utility function, then information seeking could have a direct impact on an individual's expected utility. In other words, social curiosity could, in part, be motivated by social preferences. In our theoretical framework, we incorporate the risk aversion parameter in both the self-interest and social components of the utility function. This modelling choice implies that, for moderate levels of risk aversion, our competitive preferences model has an unambiguous prediction of social curiosity even when this is *non-instrumental*, that is when the resulting social information cannot be used to make a decision in the task at hand.[5]

Reviews of psychological and neuroscience evidence argue for the existence of non-instrumental curiosity (Loewenstein, 1994; Szumorowska and Kruglanski, 2020; Cervera et al., 2020).[6] Within a simple deterministic economic setting, Eliaz and Schotter (2020) rule out the existence of an intrinsic preference for information. Public good contribution experiments mostly find evidence of social information seeking (Kurzban and DeScioli, 2007; Bigon and Suetens, 2012; Liu et al., 2020) but generally do not rule out this being instrumental. Different people may have different preferences for information and sorting may take place if an option to seek information is given (Akin, 2019). Agents may refuse to acquire information of its cost (Tasch and Houser, 2018), because it may damage

[4] Gneezy and Potters (1997) and Haigh and List (2005) used this method to test myopic loss aversion in the financial decisions of students and professional traders, respectively. While Charness and Gneezy (2012) and Gneezy et al. (2009), to compare gender differences in risk attitudes. Cohn et al. (2015) provide evidence for countercyclical risk aversion with financial professionals while Cohn et al. (2017) explore whether professional norms in the banking industry favor risk taking.

[5] We see as intuitive that a risk averse agent who also has social preferences, has a dislike towards risk related to where he or she ends up relative to another agent. We borrow the distinction of instrumental and non-instrumental social curiosity from Tasch and Hauser (2018). However, while in their experiment, curiosity is considered instrumental if it allows subjects to revise their beliefs regarding their co-participants' contributions to the public good, in our experiment, we consider curiosity instrumental if subjects can receive social information about the task in hand before making their investment decision.

[6] Kang et al. (2009), Gottlieb et al. (2013), Kidd and Hayden (2015) and Blanchard et al. (2015) look at the neurobiological correlates of decisions motivated by curiosity.

optimistic beliefs (e.g., Oster et al., 2013, 2016), or if all that the information does is to clarify whether others are personally accountable (Sonntag and Zizzo, 2019). Exceptions to curiosity exist depending on the nature of the information (Golman et al., 2017; Sweeny et al., 2010). It is therefore an open question whether there is social information seeking in risk taking and whether this might be instrumental, and our experiment helps answer these questions.

Overall, we find that competitive preference models best explain investment decisions, with subjects caring both about their co-participants' actions and outcomes. When controlling for the other models' predictive power, there is limited or no evidence in support of inequality aversion, loss aversion or conformism in our settings. We observe that 90% of subjects seek social information when it is free, and 30% seek it when it is costly but instrumental for their own investment decision. If social information is costly and not-instrumental, the proportion of subjects who seek it ranges from 10% to 20%, depending on the setting. Subjects whom our structural estimations identify as competitive are more likely to choose to observe social information, in line with theoretical predictions.

The remainder of this article is structured in the following manner. In section 2, we provide a brief overview of the experimental literature on social embedded risk-taking. In section 3, we introduce our theoretical framework. In section 4, we describe our experimental design and the procedures of the experiment. Section 5 reports the experimental results, and section 6 discusses our findings and concludes the paper. In the online appendix, we provide the instructions, and some additional econometric analysis that act as robustness checks.

2. Literature Review: Experimental evidence

There are evolutionary reasons that could explain why risk taking is socially embedded. Relative performance is essential in the competition for mating and resources (Mishra et al., 2014; Hill and Buss, 2010; Ermer et al., 2008), while risk-sensitivity theory suggests that organisms take more risks when they see themselves competitively disadvantaged, even in the lack of direct competition with others (Mishra et al., 2014). Physiological evidence from EEG, heart rate, and skin conductance responses suggest that risky choices lead to significantly greater emotional arousal when social comparisons are possible in actions, comparative outcomes or both (Bault, 2008; Luo et al., 2015).

While there is a large body experimental evidence on the social embeddedness of risk taking (see footnote 1 above),[7] this evidence is mixed on what models are better suited for explaining how risk taking and peer effects interact.[8] In Bault et al. (2008), participants choose between pairs of lotteries with different levels of risk, while observing the choice of a coparticipant. Their findings suggest that a general additive competitive outcome-driven preferences model appears to be more consistent with the aggregate data patterns than prospect theory, a finding supported by Linde and Sonnemans (2012). Building on these findings, Fafchamps et al. (2015) test additive outcome-driven reference-dependent and competitive preferences models in a repeat lottery setting in which participants are in matched groups. In their setting, subjects observe how much money the others have but do not directly view their actions. The results favour competitive preference models over reference-dependent ones, suggesting a competitive need to keep up with the winners. Dijk et al. (2014) claim that competitive preferences can help explain experimental asset portfolio choices.

In these papers, a person who falls behind can potentially overtake their peer; this is not the case in the multiple price list experiment carried out by Gamba et al. (2017), and this difference in designmay partially explains the contrasting results. Cooper and Rege (2011), in an experiment that allows them to compare a behavioural conformism to a social regret model, find that the latter better explains their findings. Lahno and Serra-Garcia (2015) compare the performance of the Cooper and Rege (2011) behavioural conformism model with an additive outcome-driven competitive preferences model and find that the former has explanatory power above and beyond relative payoff outcomes. That said, they only provide information to subjects about actions rather than outcomes. Conversely, Gantner and Kerschbamer (2019) focus only on payoff outcomes and find evidence of convexity in distributional preferences, which is consistent with a range of outcome-driven models. Hillebrandt and Steinhorth (2020) cleverly identify the effect of relative payoff differences as opposed to the effect to difference in just absolute income.[9] They similarly focus purely on payoff outcomes and find evidence in support of competitive preferences.[10]

[7] Trautmann and Vieider (2012) is an early review of the literature. Not all of these studies are with standard Western university student samples: Fafchamps et al. (2015) employ Ethiopian farmers and university students; Balsa et al. (2015) use high school students from Uruguay; while Lopera and Marchand (2018) rely on Ugandan entrepreneurs.

[8] Fudenberg and Levine (2012) and Saito (2013) provide normative axiomatizations of the implications of social preferences for decision making under risk, differentiating ex ante from ex post fairness. Like other experimental research, our focus is empirical, and primarily focusing on ex ante decisions (and ex post decisions only insofar as they may lead to changes in ex ante decisions due to anticipation). Maccheroni et al. (2012) also provide an axiomatic characterization. Fornasari et al. (2019) show the importance of combining social preferences with risk preferences when making risky decisions on behalf of others, and review relevant literature.

[9] Chao et al. (2017) instead has both absolute and relative payoff differences and rely on a reference-dependent model.

[10] Decheneux et al. (2014) survey evidence on the potential role of outcome-based competitive preferences (relative payoff maximization) and utility from winning to explain overbidding in Tullock contests. Breitmoser et al. (2010) show that there

In the context of a real effort task where both actions and outcomes are known, Brookins et al. (2016) find no evidence of peer effects in relation to actions but that the level of risk-taking increases as the gap between participants' performances grows.[11] Friedl et al. (2014) focuses on inequality aversion in the context of insurance demand. Schwerter (2015) provides evidence in favour of social loss aversion relative to inequality aversion, though this is based simply on the lack of predictive power of dictator games play on risk taking. Instead, Müller and Rau (2019) demonstrate both theoretically and experimentally that individual risk aversion is attenuated when lagging behind peers, whereas it is amplified under favourable income inequality. They point out that the majority of their findings could not be explained via rank dependent preference models or cumulative prospect theory.[12]

Overall, the experimental evidence is mixed on what models are better suited for explaining how risk-taking and peer effects interact. One issue is that each study employs a somewhat different design, making it hard to draw direct comparisons between them. Another key issue is that most studies have focused on either testing the plausibility of one particular motivation in isolation or, at best, comparing two or three different potential motivations. Our theoretical framework and experiment enables us to test among multiple different motivations, with self interest with risk aversion as a benchmark. The brief review of the literature above shows that outcome driven inequality aversion (e.g., Müller and Rau, 2019; Friedl, 2014), outcome driven competitive preferences (e.g., Bault et al., 2008; Hillebrandt and Steinhorth, 2020), and behavioral conformism (e.g., Lahno and Serra-Garcia, 2015; Cooper and Rege, 2011) have all been tested, and we too test them within our generalized BO model. By testing social loss aversion, we also capture the desire to take more risk when being behind the reference point (e.g., Schwerter, 2015). We also have an action driven competitive preferences model, reflecting the intuition that people may compete in how much effort they are putting in (risk being taken).[13]

is evidence of overinvestment in races with uncertainty and multiple prizes, and that an additive outcome-based competitive preferences model can help explain this.

[11] The gap may itself be endogenous to an individual's own unobservable characteristics, but Gill et al. (2020) control for this and still find an effect of comparative payoffs, particularly at the top and the bottom of the earnings distribution (for the latter, see also Kuziemko et al., 2014).

[12] We would like to also bring the attention of the reader to the studies of Viscusi et al. (2011) and Gioia (2017), which focus on the effects of groups on risk taking, and Gortner and van der Weele (2019) that examines an experimental asset market interaction as predicted by a general equilibrium model with inequality averse preferences.

[13] Examples where this looks intuitive include social peer effects connected to youth alcohol and substance abuse (e.g., Kremer and Levy, 2008; Lundborg, 2006), where, for example, the status competition may be in who drinks the most.

3. A Generalized BO theoretical framework

Suppose subject i must choose how much they wish to invest, $x_i \in [0, X_i]$, in a lottery that yields a dividend $d_i = k * x_i$ with probability p, and nothing with probability $1 - p$. Consequently, the expected profit of the lottery for decision maker i with endowment X_i, is given by:

$$E(\pi_i) = X_i - x_i + p * k * x_i \tag{1}$$

Notice that when $k > 1$, the lottery is more than actuarially fair, as $\frac{\partial E(\pi_i)}{\partial x_i} > 0$ and $\frac{\partial^2 E(\pi_i)}{\partial {x_i}^2} = 0$. For the rest of our analysis, we are going to assume $k > 1$, and thus retain the above as given. Furthermore, we are going to we assume that i exhibit constant relative risk aversion, r (CRRA).[14] The expected utility of the lottery is then given by:

$$EU(\pi_i) = u(x_i, r) = p\frac{(X_i - k * x_i)^{1-r}}{1-r} + (1-p)\frac{(X_i - x_i)^{1-r}}{1-r} \tag{2}$$

Let x_i^*, denote the value that maximizes $EU(\pi_i)$. As $EU(\pi_i) \in \mathbb{C}^2$, and $EU''(\pi_i) \neq 0 \; \forall \; x_i \in [0, X_i]$, it follows that if $r \leq 0$, $EU(\pi_i)$ is maximized only at $x_i^* = X$. If $r > 0$, $EU(\pi_i)$ is concave with a unique global maximum $x_i^* \in (0, X_i)$. Formally, $\forall r \in \mathbb{R}, \; \exists x_i^* \in [0, X] \Rightarrow u_i(x_i^*, r_i) \geq u_i(x_i, r_i) \forall x_i \in [0, X] \wedge \; x_i \neq x_i^*$.

We will now present a set of social preference models built around the Bolton and Ockenfels (2000) inequality aversion model. Let us refer to the expected utility function of agent i in general form by:

$$v_i(x_i) = u(x_i, r) + \; s_i\big(x_i, x_j, \alpha_i, r\big) \tag{3}$$

Where $u(x_i, r)$ refers to the expected consumption utility and $s_i\big(x_i, x_j, \alpha_i\big)$ the expected social utility. Scalar $\alpha_i \in \mathbb{R}_+$, captures the importance i assigns to social utility relative to consumption utility, and x_j, π_j denote, respectively, the investment decision and profit of a reference agent j. We are going to assume that v_i is continuous and twice differentiable and that for a given relative payoff, each player's utility is increasing with respect to income.

[14] CRRA has the advantage that it is still a valid measure of risk aversion, even if the utility is not strictly convex/concave over all levels of wealth.

***Table 1**: Generalized BO theoretical framework: utility functions*

	$\delta_i < \delta_j$	$\delta_i = \delta_j$	$\delta_i > \delta_j$
Self-Interest	$u(x_i, r)$		
Competitive preferences (Outcome driven)	$u(x_i, r) + \alpha_i \frac{\left(\frac{E(\pi_i)}{E(\pi_i)+\pi_j}\right)^{1-r}}{1-r}$		
Competitive preferences (Action driven)	$u(x_i, r) + \alpha_i \frac{\left(\frac{x_i}{x_i+x_j}\right)^{1-r}}{1-r}$		
Inequality Aversion (Outcome driven)	$u(x_i, r) + \alpha_i \frac{\left(\frac{E(\pi_i)}{E(\pi_i)+\pi_j}\right)^{1-r}}{1-r}$	$u(x_i, r) + \alpha_i \frac{\left(\frac{1}{2}\right)^{1-r}}{1-r}$	$u(x_i, r) + \alpha_i \frac{\left(\frac{\pi_j}{E(\pi_i)+\pi_j}\right)^{1-r}}{1-r}$
Conformism (Action driven)	$u(x_i, r) + \alpha_i \frac{\left(\frac{x_i}{x_i+x_j}\right)^{1-r}}{1-r}$	$u(x_i, r) + \alpha_i \frac{\left(\frac{1}{2}\right)^{1-r}}{1-r}$	$u(x_i, r) + \alpha_i \frac{\left(\frac{x_j}{x_i+x_j}\right)^{1-r}}{1-r}$
Social loss Aversion (Outcome driven)	$u(x_i, r) + \alpha_i \frac{\left(\frac{E(\pi_i)}{E(\pi_i)+\pi_j}\right)^{1-r}}{1-r}$		$u(x_i, r) + \alpha_i \frac{\left(\frac{1}{2}\right)^{1-r}}{1-r}$

Notes: $\delta_i = \pi_i$ for outcome-driven models, whereas $\delta_i = x_i$ for action-driven models.

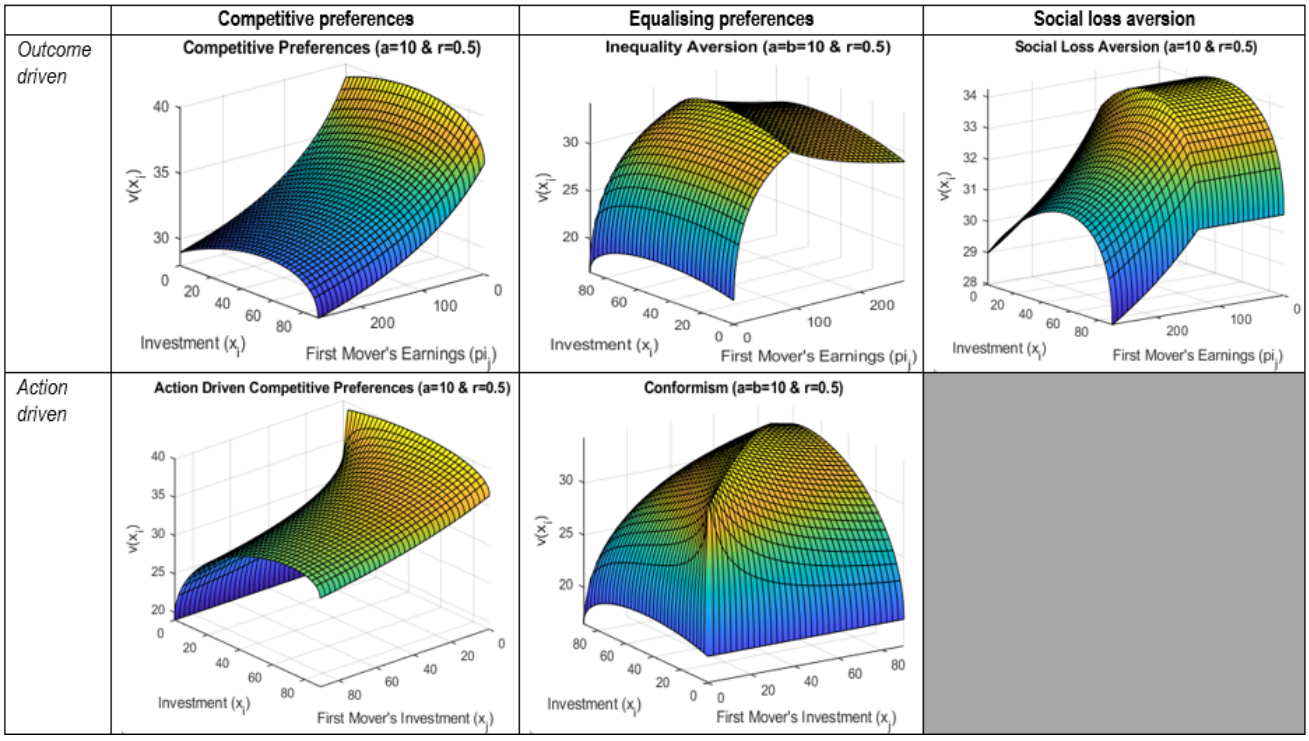
Table 1 provides an overview of the theoretical models, with self-interest acting as an initial benchmark. Depending on the model, the variables of focus $\delta_i,\ \delta_j$ are either the payoff outcomes as in the original BO model $(x,\ x_j)$ or the actions undertaken by the players $(x_i,\ x_j)$. Our models are therefore either outcome driven $(\delta_i = \pi_i)$, or action driven models $(\delta_i = x_i)$. In outcome driven models, in addition to their own payoff, the agent is also concerned about his relative payoff. In contrast, in action driven models, they are, instead, concerned with the relative levels of their actions (in our case, investments).

The competitive preferences models simply assume that the agent's social utility from having as much as possible (in the outcome driven model) or investing as much as possible (in the action driven model) relative to the other agent. Thus, in the action driven model $\frac{x_i}{x_i+x_j} = 1$ when $x_i > 0$ and $x_j = 0$, while $\frac{x_i}{x_i+x_j} = 0$ when $x_i = 0$ and $x_j > 0$. The same logic applies to the outcome driven model. In both competitive preference models, $s_i' > 0\ \forall x_i, x_j \in [0, X]$.

The outcome driven inequality aversion model is the traditional BO model where the social utility is maximal at an equal split $\frac{1}{2}$. We model behavioral conformism by using actions (i.e., the amount invested by i and j) as the reference point. Thus, under behavioral conformism the agent wants their

action to be as close as possible to the action of the other agent. In both models and $s_i' > 0$ if $x_i < x_j$and $s_i' < 0$ when $x_i > x_j$. The social utility of a social loss averse agent increases as his own payoff approaches that of agent j, but is equal to $\frac{1}{2}$ when $x_i \geq x_j$. Thus, $s_i' > 0$ if $x_i < x_j$ and $s_i' = 0$ when $x_i \geq x_j$.

***Figure 2**: 3D presentation of predictions of social preference models*



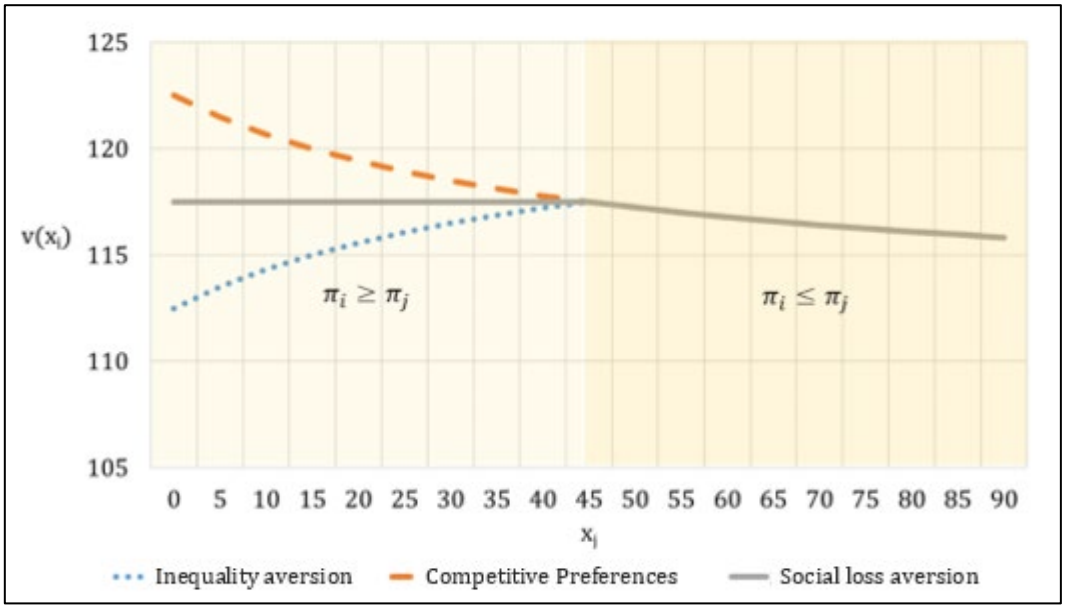
Notes: In the above examples we assume agent's i, r = 0.5 and the social preference parameter a =10. Agent i's utility is displayed on the vertical axis. Own investment, x_i, and agent j's investment x_j. or payoff outcome π_j, are shown on the horizontal axes.

Figure 2 provides an illustrative representation of an agent's i, utility function $v(x_i)$ for each of our models in a three dimensional space; assuming moderate risk aversion $r = 0.5$; a social preference parameter $a = 10$; and, as in the experiment, agents having 90 experimental currency units (ECU) none, some or all of which they can invest in a lottery providing thrice the return. Own investment, x_i, and agent's j earnings, π_j, are shown on the horizontal axes and i's utility on the vertical axis. In all models, the agent's risk attitudes shape the curvature of the utility function with respect to their own investment decision.

A key feature of all three outcome-driven models is that they share the same motivation function when the payoff of agent i is lower or equal to that of agent j (i.e., when $\pi_i \leq \pi_j$). Figure 3 provides an illustrative example, in a two dimensional space, of an agent's i motivation function, under inequality aversion, competitive preferences and social loss aversion, assuming the agent is risk neutral and $x_i =$

45. The same feature applies to our two action-driven models. While both conformist and competitive agents share the same utility function when $x_i \leq x_j$; when $x_i > x_j$, competitive agents enjoy an increase in utility the greater the difference between their own action and that of j, whereas conformist agents suffer disutility from the difference in action.

***Figure 3**: Outcome–driven models (illustrative example)*



Notes: Presuming agent i is risk neutral, and $x_i = 45$.

In both competitive models agent's i utility function is increasing the greater his investment is relative to j's earnings and investment decision. When the agent's risk aversion is lower than 2, in both models the agent's utility w.r.t. j's earnings/action is convex (as in Figure 3). This creates an incentive for information seeking (i.e., curiosity), as the expected (utility) return from social information is increasing.

Proposition: *An agent's utility function with respect to the competitive preference component is convex downwards when the agent's CRRA $r < 2$. Consequently, there can be non-instrumental curiosity concerning the other agent's payoff.*

Proof: what we need is to prove that the social preference element is a decreasing convex function with respect to x_j for any value of x_i. The proof is complete if $\frac{\partial s_i}{\partial x_j} < 0$ and $\frac{\partial^2 s_i}{\partial {x_j}^2} > 0$. Let us begin with the action driven model. Notice that $\frac{\partial s_i}{\partial x_j} = -\alpha_i {x_i}^{1-r}\left(x_i + x_j\right)^{r-2}$, which is negative as long as both α_i, x_i are greater than zero. Similarly, $\frac{\partial^2 s_i}{\partial {x_j}^2} = -\alpha_i {x_i}^{1-r}(r-2)\left(x_i + x_j\right)^{r-3}$, which in turn is positive

when α_i, x_i are greater than zero, and $r < 2$. A similar proof can be drawn for outcome driven competitive preferences.

Note that a necessary (though not sufficient) condition for this proposition to hold is that the social preference utility component of the utility function is a function of the individual risk coefficient. Together with ensuring comparable scaling of both the self-interest and social preference components of the utility functions in Table 1, this explains why the additional complexity introduced by doing so is required.

4. Experimental Design

The experiment consisted of three consecutive stages, named Stage 1, 2, and 3, with 18 rounds in total. These were preceded by a real effort task and followed by an end of experiment questionnaire (discussed in section 4.4). In all rounds the participants played a variant of the Gneezy and Potters (GP) task in which we varied when information about a co-participant's information was provided and whether the player could choose to observe their coparticipant's investment decision and outcome. The order of the three stages was fixed. Stages 1 and 3 consisted of one round of the GP task without social information or pairing of participants and acted as controls. Stage 2 consisted of 16 rounds of the GP task and differed with respect to when information about a co-participant was provided and whether the subject could choose to observe their coparticipant's investment decision and outcome. Stage 2 is the main part of the experiment, and it involved 8 within subject variations (explained in section 4.2). Additionally, between subjects, we varied whether information was free or costly (explained in section 4.3). In section 4.5 we present the experimental procedures.

4.1. The Gneezy and Potters (1999) risk elicitation task

In each round of the experiment the subjects played the Gneezy and Potters (1997) (henceforth, GP), risk elicitation task. In the GP task, each subject i must choose how much they wish to invest, $x_i \in [0,90]$, in a lottery that yields a dividend $d_i = 3x_i$ with probability $p = 0.5$, and nothing with equal probability. Consequently, the expected profit of the lottery for subject i is given by:

$$E(\pi_i) = 90 + 0.5x_i \tag{4}$$

Conseuquently, risk neutral and risk seeking subjects would invest their full endowment, while risk averse subjects would always invest less than their full endowment.

4.2 Within-subject treatments

In Stages 1 and 3 all subjects participated in a standard one-shot game of the GP task. In Stage 2, subjects played 16 rounds of GP tasks, differently configured in terms of sequence of information about a coparticipant's investment decision and outcome, and in terms of whether this information was given or up to whether the subject could choose to receive that information (shown in Table 3). Specifically, there were 8 task configurations. At the start of every round, subjects were randomly matched in pairs, assigned the role of a First Mover (FM) or of a Second Mover (SM). Therefore, every subject played each of the eight tasks twice, once in each role. Decisions within each round were made sequentially. FMs decided how much to invest first, while SMs decided second. FMs never had social information. They simply chose how much to invest. Importantly, they did not know what specific task the SM was facing, and they were never informed of the SMs' investment actions or outcomes, both of which were common knowledge. By asking subjects to play both roles, we can control whether playing first (as FM) or second (as SM) affects risk-taking. We adopted a *perfect stranger* design, informing subjects they will never be matched with the same co-participant twice, and randomized both the task and role order across subjects.

At the end of each experimental session, the Experimental Currency Units (ECUs) were converted into UK pounds at the exchange rate 1 ECU = GBP 0.10. Subjects obtained an initial endowment of 120 ECU at the beginning of each task. To ensure they could not end up with null payoffs and to include a show up fee, we only allowed them to invest part of their endowment in the lottery, namely 90 ECU. Across the eight task configurations, the only differences related to the information and action set of SMs, and to minimize confusion task-specific instructions were given round by round.

Tasks

In **Task D**, the SM made a lottery investment decision with no social information. We use this task to estimate the risk aversion parameter in our structural estimation in section 4.3 and as a baseline for Tasks ID and DI. Comparing the investment decision in Stage 1 to that in D allowed us to test the impact on risk attitude of assigning subjects into pairs, if any. Comparing Stage 1 to Stage 3 enabled us to test whether repetition of the GP influences individual investment decisions.

In **Task ID**, the SM received social information regarding the FM *before* making her own investment decision. As a result, we can identify the effect of having social information on risk taking decision without having to worry about any effects from sorting or from having made an active choice to take

social information (Akin, 2019). Thus, for a given estimated risk aversion parameter, Task ID can be used to estimate each subject's social preference parameter.

***Table 3**: Description of Second Movers' tasks for Stage 2.*

Task	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6
D	Instructions		Lottery Investment **D**ecision	Own lottery Outcome		
ID	Instructions		**I**nformation about FM	Lottery Investment **D**ecision	Outcomes	
DI	Instructions		Lottery Investment **D**ecision	**I**nformation about FM	Outcomes	
CID	Instructions		**C**hoice to get Social Information	**I**nformation about FM	Lottery Investment **D**ecision	Outcomes
CDI	Instructions		**C**hoice to get Social Information	Lottery Investment Decision	**I**nformation about FM	Outcomes
DCI	Instructions		Lottery Investment **D**ecision	**C**hoice to get Social Information	**I**nformation about FM	Outcomes
DOCI	Instructions		Lottery Investment **D**ecision	Own lottery **O**utcome	**C**hoice to get Social Information	**I**nformation about FM
BDOCI	Instructions	**B**elief elicitation	Lottery Investment **D**ecision	Own lottery **O**utcome	**C**hoice to get Social Information	**I**nformation about FM

Notes: tasks were presented in random order.

In **Task DI**, the SM received social information *after* making her own investment decision. This task helps us check for possible social regret in the following sense. A higher investment now means not just a higher individual risk but also a higher uncertainty with respect to where the SM will end up relative to the FM, the action and outcome of which the SM will learn just before she is informed about the outcome of her own investment decision. If the SM weighs the prospect of negative surprises due to social regret more than she does positive surprises, we should observe a lower mean investment in DI relative to D.

In **Task CID**, the SM chose whether they wish to be informed about FM investment decision and outcome *before* making her own investment decision. In CID, social curiosity can be instrumental to the investment choices subjects make. From an estimation viewpoint, for each model, the social

information (when obtained) can be used to make investment predictions for a given investment by the FM, an estimated risk parameter and an estimated social aversion parameter.

In **Task CDI**, the SM chose *before* making her own investment decision whether she wishes to receive social information *after* her own investment decision. Social information is no longer instrumental for the task at hand. Therefore, by comparing CID with CDI, this task helps us identify whether one motivation for subjects to choose social information is because they feel it may be useful for how much to invest in the task.

In **Task DCI**, the SM chose whether to receive social information *after* the investment decision. As a result, social curiosity is not instrumental. However, swapping the order of investment and social information choice allows us to control for whether the choice to observe social information is a function of prior investment, regardless of its outcome.

In **Task DOCI**, the SM chose whether to receive social information *after* she learns about her own investment outcome. Consequently, curiosity cannot be instrumental and this task acts as a control for whether the choice to observe social information is a function of one's own outcome. For example, for a given level of investment, a subject who experienced an unfavorable lottery outcome motivated by social regret might be less likely to seek information than a SM whom received a positive outcome; if the dread of learning that the FM has won weighs more heavily than the relief that he has also lost it. Furthermore, DOCI allows us to control for the effect of having belief elicitation at the beginning of task as in the next and final task.

In **Task BDOCI**, the SM is asked to guess how much the FM invested in the lottery. If the guess is accurate, a bonus of 25 ECU is given. A penalty of 5 ECU is given for each point the guess is off the correct response, with 0 ECU earned if the SM's belief was off by more than 5 ECU from the FM's investment. As in DOCI, the order of the tasks helps isolate the investment decision from the social information choice, while taking advantage of DOCI as a control for eliciting beliefs before subjects' investment decision. Different social preference models may make different investment predictions for a given expected investment by the FM (elicited by all subjects through the belief elicitation), an estimated risk parameter and an estimated social aversion parameter. Unlike for Task CID, model-based investment predictions can be identified for all subjects.

Where social information was available to the SM, this included both the investment choice and the lottery outcome of the FM. This is essential for our identification strategy for two reasons. First, it makes actions and outcomes equally salient, without skewing the attention of subjects to one or the other, which could artificially lead to an action driven or an outcome driven model performing better.

Second, any positive (expected or known) level of investment by the FM will equally impact on the investment of the SM according to the action driven models of section 2, but, since there is a 50% exogenous probability of win or loss, the predictions for the level of investment of the SM will generally be different depending on whether the FM wins or loses the lottery. This will enable us to separately identify the predictive role of outcome driven relative to action driven models. Conversely, if we only provided investment information, action driven model would be difficult to separate from outcome driven models, since expected outcomes would be increasing with investment. If we only provided outcome information, for subjects driven by action driven models, it would technically be possible to infer actions from outcomes with our binary lotteries, but this would be cognitively difficult.

4.3 Free and Price Treatments

We varied whether social information in Stage 2 is *Free* or available at a *Price* in *between-subjects* treatments. In the Free treatment, social information was free. In the *Price* treatment, social information was provided at a price of 10 ECU (which corresponds to 12% of subjects' initial endowment, but still enabling subjects to invest a full 90 ECU if so they wished).

4.4 Additional Controls

The initial real effort task was introduced at the beginning of the experiment to control for house money effects. The real effort task consisted of counting zeros in 20 tables including 0 and 1s (Abeler et al., 2009). Subjects obtained an endowment of 120 ECU (Experimental Currency Unit) upon completing the real effort task, to be used in the rest of the experiment (see instructions in the online appendix). As soon as subjects solved correctly 20 tables, the real-effort task ended. There were no time limits to complete the real effort task, and everyone did so successfully and so started off with the same endowment.

Furthermore, at the end of the experiment, subjects were asked to answer a computerized questionnaire. It included basic demographics variables such as age, gender, native language, whether the subject is a student, an undergraduate student, the area of study and whether the subject studied economics. Subjects were also asked to answer a few questions providing additional controls, namely

for sensitivity to social pressure through the SDS-17 Social Desirability Scale (Stöber, 2001) and for self esteem through Rosenberg's (1979) self-esteem scale.[15]

4.5 Experimental Procedures

The experiment took place in the BENC Lab located in Newcastle (UK). We conducted 13 sessions in total, 6 sessions of condition *Free* and 7 sessions of condition *Price*. Each session consisted of 16 subjects. Overall, 208 subjects participated in our experiment, of which 58% were female and 38% were Economics students. At the end of the experiment, subjects were paid according to their decisions in one of the 18 rounds, chosen at random. We chose to use a random lottery incentivising mechanism to minimize wealth effects and hedging considerations (for a discussion of the method, see Charness et al., 2016). Payments for guesses of FM's investment decision in BDOCI were in addition to round earnings.

On average, a session lasted approximately 1 hour and 20 minutes, and subjects earned an average payoff of £14.23, including a £3 show-up fee. The experiment was fully computerized in zTree (Fischbacher, 2007), and recruitment was facilitated via Hroot (Bock et al., 2012).

Table 4 summarizes the key characteristics of our subject pool by treatment. Overall, we find no statistical differences in demographic characteristics between our two treatments.

Table 4: *Demographic Characteristics by Treatment*

Treatment	N	Female	Age	Undergraduate	Native speaker	Economics	SDS-17
Free	96	.56	22.87	.37	.45	.37	9.31
Costly	112	.59	22.76	.44	.55	.32	9.49
p value for difference		0.6	0.73	0.14	0.13	0.41	0.42

5. Results

We first show and interpret some general descriptive statistics of our data. We then focus on: (i) investment decisions in D, ID and DI, where there is no or exogenously provided social information;

[15] In none of the regressions that we conducted our self-esteem measure was found to be statistically significant and it is not considered further below.

(ii) the choice whether to get social information in the other tasks, where social information is endogenous; (iii) structural estimation of our different models and identification of best fit in relation to investment decisions; (iv) the prediction from our competitive preferences model regarding the choice whether to get social information.

5.1 Descriptive Statistics

Table 5 summarizes the mean investment and proportion of subjects who chose to collect social information (where applicable) across tasks.

Table 5: *Summary of Mean Investment and Choice to observe Social Information (SI) by Task*

Task	Investment		Choice to observe SI	
	First Mover	Second Mover	Free	Costly
Round 1	43.6		-	-
D	44.077	43.120	-	-
ID	45.639	41.827	-	-
DI	41.904	40.481	-	-
CID	43.014	41.486	0.906	0.303
CDI	42.529	42.014	0.906	0.178
DCI	42.952	40.837	0.885	0.125
DOCI	41.226	42.885	0.843	0.089
BDOCI	41.428	42.063	0.916	0.196
Round 18	46.716		-	-

Overall, we find that investment levels are rather stable with no statistically significant differences between roles (Mann-Whitney: $p = 0.74$) or price treatments (Mann-Whitney: $p = 0.77$). This is to be expected for FMs, where in all tasks their information set is identical. However, as we show in the following sections, the aggregate picture for SMs investment decisions masks significant individual differences that are driven by subjects' social preferences.

Observing that mean investment in DI is no lower than in D (Mann-Whitney: $p = 0.74$)[16] or ID (Mann-Whitney: $p = 0.93$) suggests that social regret aversion is not a concern in our setting, i.e., that subjects are not discouraged from investing out of the possible social regret emerging from learning about the other subject's investment and outcome after they have made their choice.

[16] All statistical tests in this paper are two-sided.

The mean investment in Stage 1 (round 1) and Stage 3 (round 18) are not significantly different either (Mann-Whitney: $p = 0.39$), which is reassuring as it suggests that the subject's individual risk attitude is unchanged throughout the experiment. Also, Round's 1 mean investment is the same as that in D (Mann-Whitney: $p = 0.89$), implying that simply being matched with another subject does not change risk taking; which enables us, in Section 4.3, to use investment choices in D to estimate the individual risk aversion parameter without having to worry that having the subjects paired may act as a confound.

When social information is free, around nine out of ten subjects are curious about the FM's investment decision regardless of the task.[17] The number of times SM's choose to observe their partner's investment decision is significantly higher than a 50% benchmark, assuming purely self-interested expected utility maximizers are indifferent (Sign test: $p<0.01$). When social information is costly, self-interested expected utility maximizers should never seek social information. However, three out of ten subjects are still willing to pay to observe the FM's investment decision in CID where social information may be instrumental for the investment decision in the task as in CID. Furthermore, when social information is costly but non-instrumental for the task, subjects choose to observe social information between 10 and 20% of the time. Overall, we find that when being curious is costly but instrumental (CID), SMs are significantly more likely to choose to observe the FM's choice than when it is not instrumental (CID vs. CDI Mann-Whitney: $p = 0.03$; CID vs. DCI Mann-Whitney: $p = 0.01$; CID vs. DOCI Mann-Whitney: $p < 0.01$; CID vs. BDOCI Mann-Whitney: $p = 0.07$). As the difference between CDI and DCI is not statistically significant (Mann-Whitney: $p = 0.32$), we do not find evidence that seeking social information is a function of prior investment regardless of outcome. Similarly, we find no evidence that the choice to observe social information is a function of one's own outcome when we compare DCI to DOCI (Mann-Whitney: $p = 0.72$) or of whether the outcome of the lottery was favorable vis a vis unfavorable in DOCI (Mann-Whitney: $p = 0.72$) or in BDOCI (Mann-Whitney: $p = 0.84$).

Turning our attention to time trends, Figure 4 shows mean investment levels and choice to get social information over time. Specifically, the left panel displays mean investment decisions by role and treatment, whereas the right panel displays the proportion of subjects who chose to observe social information by treatment. The key observation that stems from the left panel is that mean investment remains relatively constant across time regardless of role or treatment. In the right panel, we see that when social information is free, subjects are equally socially curious across the experiment. When social information is costly, we see a small declining trend, primarily driven by many subjects choosing to observe social information in the first five rounds of the experiment, where the proportion of subjects

[17] None of the within treatment differences are statistically significant.

who choose to observe social information ranges between 20% and 40%. However, from round 5 onwards, social information stabilizes between 5% and 20%. Recall that SMs knew that they were matched with a different FM every time, and so past investment decisions are not at least directly informative for how future FMs will behave. It is still possible that social information may contain some value about how future matches drawn from the same population will behave. The stability in social curiosity from round 5 onward corroborates the conjecture that there may be a degree of social curiosity that is non-instrumental not just for the task at hand but also in future tasks. This is also supported by the fact that, when social information is free, 90% seeks it even in the last round.

***Figure 4**: Mean Investment and Social Information Choice over time*

5.2 Exogenous social information and investment decisions

We start our analysis by examining the influence of exogenously given social information regarding the First Mover's investment decision to the Second mover's own investment.

We observe no aggregate differences in investment decisions when social information is provided before (Mann-Whitney: p=0.77) or after (Mann-Whitney: p=0.74) relative to a baseline of no social information. But our non-parametric tests do not account for what individual information is actually provided. Table 6 reports random effects Tobit regressions on SM's investment decisions censored at 0 and 90 (i.e., minimum and maximum possible investment). In model 1, we use treatment dummies

for ID and DI while D acts as the baseline. We again find no net effect of having or the prospect of having social information on aggregate investment level. The latter result speaks against social regret being a motivator of investment decisions.

Table 6: *Random-effects Tobit regression on Investment by SM*

Investment	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
ID	-1.536 (2.23)	-8.625** (3.88)	-10.608*** (3.76)	-15.143*** (4.60)	-15.802*** (4.54)	-2.253 (2.21)
ID * FM Profit		0.050** (0.02)		0.039* (0.02)	0.041* (0.02)	
ID * FM Investment			0.198*** (0.07)	0.177*** (0.07)	0.170*** (0.07)	
DI	-3.083 (2.23)	-3.082 (2.22)	-3.061 (2.21)	-3.062 (2.20)	-4.130** (2.20)	-4.147* (2.20)
Round					0.779*** (0.23)	0.776*** (0.24)
Female					-16.984*** (3.95)	-17.243*** (3.97)
Economics					-8.164* (4.04)	-7.876* (4.05)
Age					-0.411 (0.457)	-0.411 (0.458)
SDS					-1.036 (0.738)	-1.048 (0.741)
Constant	44.711*** (2.39)	44.707*** (2.38)	44.702*** (2.37)	44.700*** (2.37)	69.996*** (12.40)	70.537*** (12.46)
Wald χ^2	1.92	6.90	10.83	13.78	47.01	34.81
N	624	624	624	624	624	624

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in brackets. Investment levels are censored at 0 and 90. Random effects control for individual level non-independence of observations. ID, DI, Female, Economics are dummy variables. SM could only condition their investment on the FM's profit and investment in the ID treatment. SDS is the SDS-17 questionnaire value.

If we introduce ID * FM Profit (model 2) or ID * FM Investment (model 3) in the regression, however, we find that the SM's investment decision is significantly influenced by social information. Profits and investment are linearly related by construction and indeed strongly positively correlated ($\rho = 0.218$, $p < 0.01$). In models 4 and 5, we include both interaction variables to disentangle the effects of observing the First Mover's investment decision from the First Mover's profit. Despite the two variables being linearly related, both coefficients are positive and significant as predicted by our social preference models (at $p < 0.1$ or better in two-sided tests), providing preliminary evidence to the effect that both

action and outcome considerations play a role on Second Mover's investment decision. Model 6 has additional controls, allowing for which DI now does exhibit a minor decrease in investment relative to D in the direction of social regret. In line with previous research (Gneezy and Potters, 1999), we find that women tend to exhibit higher risk aversion in the GP task.

Result 1. *SMs' investment decisions are a positive function of FMs' investment and profit, suggesting that both the FM's actions and outcomes influence the SM's decisions.*

5.3 Choosing to observe Social Information

We now focus on whether subjects chose to get social information. Table 7 presents random effects panel Probit regressions on the SMs' choices to observe social information clustered at session level. Overall, our regression analysis corroborates our descriptive statistics. In both models, we find that social information is selected less often when information is costly, in line with Table 5. To evaluate the impact of when the choice to observe social information is provided, we use CID as the baseline. All treatment dummies (i.e., CDI, DCI, DOCI and BDOCI) are negative and statistically significant. The negative sign implies that the demand for social information is greater when social curiosity is instrumental for the task at hand, as in CID. The coefficient on DCI is lower than that on CDI, but not significantly so ($p = 0.189$), and similarly in relation to the coefficient on DOCI relative to that on DCI ($p = 0.124$). The order of investment decision and social information choice does not appear to matter per se. Nor is there any evidence that social regret from the possibility of learning that the FM has won after learning about one's own outcome matters. We do find that the difference between CDI and DOCI is statistically significant ($p < 0.01$). Such effect appears fragile however, as it is more than offset if we add belief elicitation at the beginning, with the coefficient on BDOCI being significantly negative relative to the CID baseline at $p < 0.1$, and being significantly higher than that on DOCI ($p < 0.01$). In BDOCI, by choosing to observe social information, subjects could infer whether they had provided a correct guess during the belief elicitation.

In line with Figure 4, Model 2 has a statistically significant time trend, which Figure 4 shows to be driven by the costly information treatment where it goes down to a 10-20% social curiosity rate. Online appendix 2.1 and section 5 unpack this further to identify the extent to which this may be explained by social curiosity instrumental for future decisions. Our measure of sensitivity to social pressure is marginally statistically significant ($p < 0.1$).

Table 7: *Random-effects Probit regression on Choice by SM*

Choice	Model 1	Model 2	Model 3	Model 4
Costly	-0.710*** (0.03)	-0.709*** (0.03)	-0.711*** (0.03)	-0.709*** (0.03)
CDI	-0.061** (0.02)	-0.062** (0.02)	-0.102** (0.04)	-0.099** (0.02)
DCI	-0.105*** (0.03)	-0.101*** (0.03)	-0.152*** (0.05)	-0.146*** (0.03)
DOCI	-0.143*** (0.03)	-0.143*** (0.03)	-0.218*** (0.04)	-0.209*** (0.03)
BDOCI	-0. 049* (0.02)	-0. 051* (0.03)	-0. 071* (0.04)	-0. 066* (0.03)
Investment	-0.001 (0.00)	-0.001 (0.00)	-0.001** (0.00)	-0.001** (0.00)
CDI * Inv.			0.001 (0.00)	0.001 (0.00)
DCI * Inv.			0.001 (0.00)	0.001 (0.00)
DOCI * Inv.			0.001 (0.00)	0.001 (0.00)
BDOCI * Inv.			0.002** (0.00)	0.002** (0.00)
Round		-.0006** (0.00)		-.0007** (0.00)
Female		0.069 (0.04)		0.069 (0.04)
Economics		0.035 (0.03)		0.035 (0.03)
Age		0.006 (0.00)		0.007 (0.00)
SDS		0.013* (0.00)		0.013* (0.00)
Constant	6.142*** (0.59)	0.715 (0.99)		0.715 (0.99)
Wald χ^2	201.10	699.55	2353.36	2683.43
N	1040	1040	1040	1040

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in brackets (clustered at session level). Random effects control for individual level non-independence of observations. CID is the baseline treatment. Marginal effects coefficients are presented. Costly, CDI, DCI, DOCI, BDOCI, Female and Economics are dummy variables. Investment refers to investment by the SM in the same task. SDS is the SDS-17 questionnaire value.

Result 2. *Subjects are socially curious 90% of the time when social information is free. When it is costly and socially instrumental for the task at hand, the social curiosity rate is around 30%. When it is costly and not socially instrumental for the task at hand, the social curiosity rate is around 10-20%.*

4.3 Estimation of social preference models

In this section we estimate and test the different social preferences models, both on their own and against each other. As noted, we use task D to estimate subjects' risk aversion, and task ID to estimate a social preference parameter at individual level for a given level.[18] We then use these estimates to predict the SMs' investment decisions in CID (for SMs who have obtained social information before their decisions) and in BDOCI (for all SMs, as we have their elicited beliefs on FMs' investment in this task).

Table 8 provides the proportions of subjects for whom, based on their decisions in ID, we were able to estimate a social preference parameter $\alpha_i > 0$ for each of our models. Overall, we find that, depending on the model, between around 30% and 45% of subjects exhibit social preferences. The highest proportions are estimated for competitive preferences models, potentially a first indication of better goodness of fit.

Table 8: *% of subjects with* $\alpha_i > 0$ by model

	Competitive preferences	**Equalizing preferences**	**Social loss aversion**
Outcome driven ($\delta_k = \pi_k$)	46%	38%	36%
Action driven ($\delta_k = x_k$)	44%	31%	

Online appendix 2.2 provides histograms both of estimated r_i and α_i distributions.

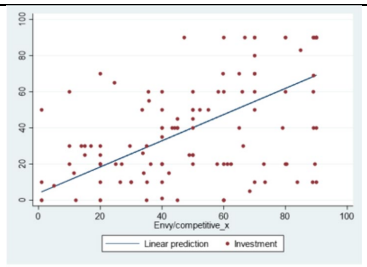
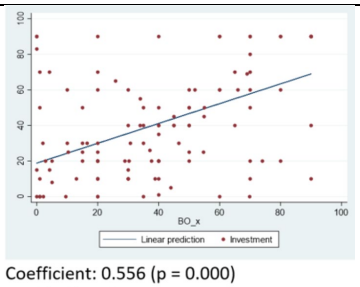
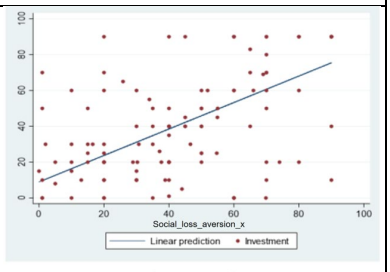
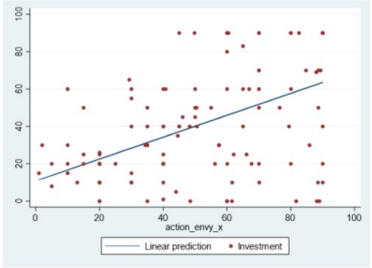
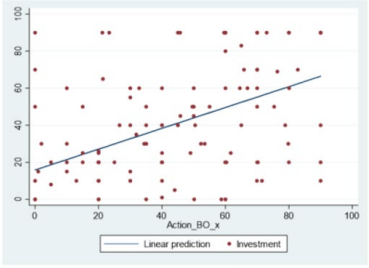
4.4 Comparison of social preference models

We now shift our attention to the predictive power of each of our five models in explaining the investment decision of subjects in CID and BDOCI. Figure 5 reports the results of univariate random effects Tobit regressions testing each model separately in each of the two games.

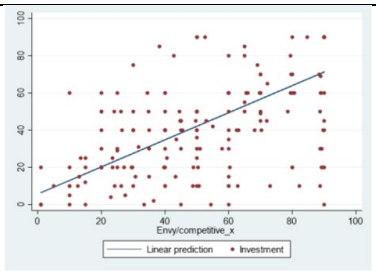
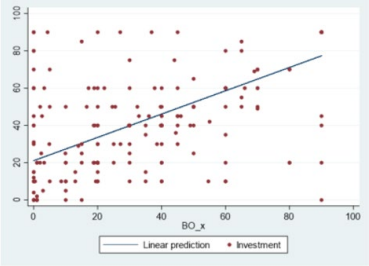
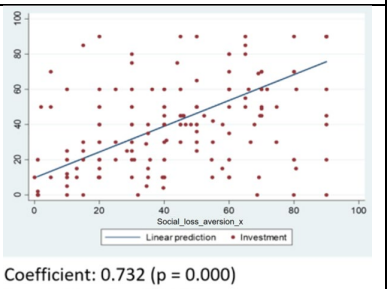
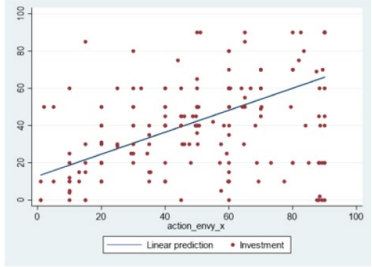
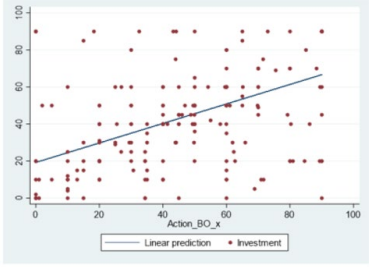
[18] Specifically, as in ID the SM observes the FM's investment decision and payoff outcome, for a given risk attitude as estimated from D, we can estimate the social preference parameter for each subject.

Figure 5: *Univariate Tobit regressions on the predictive power of each social preference model on SMs' investment in CID and BDOCI*

(a) CID

	Competitive Preferences	*Equalizing preferences*	*Social Loss Aversion*
Outcome driven	 Coefficient: 0.724 (p = 0.000) Log likelihood = - 482.672	 Coefficient: 0.556 (p = 0.000) Log likelihood = - 491.399	 Coefficient: 0.739 (p = 0.000) Log likelihood = - 483.781
Action driven	 Coefficient: 0. 585 (p = 0.000) Log likelihood = -489.821	 Coefficient: 0.562 (p = 0.000) Log likelihood = -491.258	

(b) BDOCI

	Competitive Preferences	*Equalizing preferences*	*Social Loss Aversion*
Outcome driven	 Coefficient: 0.728 (p = 0.000) Log likelihood = - 837.758	 Coefficient: 0.624 (p = 0.000) Log likelihood = - 846.926	 Coefficient: 0.732 (p = 0.000) Log likelihood = - 837.849
Action driven	 Coefficient: 0.589 (p = 0.000) Log likelihood = -854.892	 Coefficient: 0.526 (p = 0.000) Log likelihood = -862.068	

Notes: CID: n=121, BDOCI: n=208. p-values are based on robust standard errors in parentheses (clustered at session level). Random effects control for individual level non-independence of observations.

There are three take home messages from this univariate analysis. First, taken on their own, the outcome driven competitive preferences model and the social loss aversion model appear to have the

best fit. Second, notwithstanding this, *all* models have got a very good fit, plausibly due to covariation in predictions among the models. This stresses the importance of pitting the models against each other to see which one or ones best capture the data, on their own or in combination. Third, the first two key points are true for both CID and BDOCI. The fact that for CID we only have subjects who chose to have social information does not, therefore, seem to be a cause of concern.

Table 9 *Random-effects Tobit regressions on SMs' investment in CID & BDOCI*

Investment	***CID***		***BDOCI***		***CID & BDOCI***	
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
Outcome Competitive	0.455***	0.433***	0.327***	0.299***	0.409***	0.381***
	(0.16)	(0.17)	(0.11)	(0.11)	(0.10)	(0.10)
Action Competitive	0.413**	0.436**	0.346***	0.349***	0.430***	0.439***
	(0.20)	(0.20)	(0.12)	(0.12)	(0.11)	(0.11)
Inequality Aversion	-0.110	-0.135	0.184**	0.164*	0.053	0.034
	(0.19)	(0.19)	(0.09)	(0.09)	(0.08)	(0.09)
Conformism	-0.180	-0.220	-0.181	-0.180	-0.222**	-0.224**
	(0.22)	(0.22)	(0.11)	(0.11)	(0.11)	(0.11)
Social Loss Aversion	0.289	0.320	0.090	0.119	0.135	0.151
	(0.29)	(0.29)	(0.14)	(0.13)	(0.14)	(0.14)
Risk Aversion	-0.668	-0.913	-1.815***	-1.676***	-1.569***	-1.548***
	(0.99)	(0.99)	(0.60)	(0.60)	(0.58)	(0.58)
Female		-4.588		-3.679		-5.229
		(5.77)		(3.59)		(3.51)
Economics		7.750		-4.038		0.001
		(5.69)		(3.62)		(3.54)
Age		0.252		-0.361		-0.137
		(0.62)		(0.41)		(0.39)
SDS		-0.593		-0.795		-0.906
		(1.03)		(0.65)		(0.64)
BDOCI						0.911
						(2.52)
Constant	-2.149	1.564	9.005**	32.294*	4.370	19.395*
	(7.70)	(20.11)	(4.70)	(11.98)	(4.58)	(11.73)
Wald χ^2	54.55	58.62	141.26	148.83	153.96	158.49
Obs	121	121	208	208	329	329

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Robust standard errors in brackets. Investment levels are censored at 0 and 90. Random effects control for individual level non-independence of observations. Risk aversion is the estimated *r* coefficient of risk aversion from Round 1. Female and Economics are dummy variables. SDS is the SDS-17 questionnaire value.

Table 9 reports random effects Tobit regressions jointly testing the predictive power of the different social preference models on SM investment decisions. Regressions 1 and 2 use the data from CID,

regressions 3 and 4 use the data from BDOCI, and regressions 5 and 6 put together the data from CID and BDOCI. The models use the predicted investment decisions from each social preference model as an independent variable. Regressions 2, 4, and 6 also add while the second model in each group includes controls for subject specific characteristics. In CID, we can only use the data of subjects who got the social information, and so we only have 121 observations. In BDOCI, we use the SMs' beliefs regarding the FMs' investment and expected profit, leading 208 observations.

All regressions show a statistically significant and large predictive power for both the outcome and the action driven competitive models. Inequality aversion has some limited predictive power in BDOCI, but this is only at $p < 0.1$ when controls are added and is not present for the sample of subjects who got social information in CID, or overall. Social loss aversion is always statistically insignificant, while the coefficient on the conformism coefficient is wrongly signed. There is some additional predictive power of the risk aversion coefficient that is not captured in our models, though this is not statistically significant in CID. Overall, however, the goodness of fit of the different models is robustly similar for both the CID and the BDOCI data.

Result 4. *Outcome and action driven competitive preferences jointly predict the SMs' investment decisions. When controlling for the other models' predictive power, there is no or limited evidence in support of inequality aversion, loss aversion or conformism.*

4.5 Instrumental curiosity

A key result of our analysis of the competitive preference models in section 3 is that individuals who exhibit competitive preferences, should seek social information when their risk aversion parameter $r < 2$ if the price is not too high and regardless of any instrumental reason for getting social information. In this section we test this hypothesis. Table 10 in section 4.3 shows around 45% of subjects being classifiable as having either outcome driven or action driven competitive preferences in either of the two games . Around 90% of these sbjects have $r < 2$.

Subjects without competitive preferences choose social information around 50% of the time (Fisher exact: $p > 0.1$). In contrast, out of the subjects who were classified as outcome (action) based competitive, 62% (64%) chose to observe social information, which is statistically significantly different from both a 50% benchmark and our non-competitive sample (Fisher exact: $p<0.01$ in all cases). We will discuss more why subjects with non-competitive preferences may seek social information in the next section.

Table 10: Percentage of subjects who choose to observe social information in CID and BDOCI

	Choice		
CID	*No*	*Yes*	*Total*
Non-competitive	51%	49%	*100% (204)*
Outcome competitive (r < 2)	38%	62%	*100% (164)*
BDOCI			
Non-competitive	52%	48%	*100% (206)*
Action competitive (r <2)	36%	64%	*100% (162)*

Notes: Fisher exact test (1 sided) $p<0.01$. Total number of subjects in parentheses.

Result 5. *In line with proposition, subjects with competitive preferences are more likely to choose to observe social information.*

6. Discussion and Conclusion

We presented a general theoretical framework combining a social preference parameter with a risk aversion parameter. Depending on the specification, it embeds a number of explanations for socially embedded risk taking: outcome and action driven preferences, inequality aversion, behavioral conformism and social loss aversion. All models perform well on their own in our experiment. This is consistent with the equal salience we give to the other agent's actions and outcomes when providing social information, and with the variety of models doing well in previous research when taken on their own. Nevertheless, when taken on their own, the outcome driven competitive preferences model and social loss aversion model are the most effective predictors of risk-taking decisions. When considering all the models together in a predictive horse race, the only models with strong and robust predictive power are the outcome driven and action driven competitive preferences models. Subjects with competitive preferences care both how much others invest and how much others gain.

The competitive preferences models are the clear winners of our horse race. However, Table 5 suggests greater predictive power of these models for the CID sample than for the BDOCI sample, and indeed some residual explanatory power in the BDOCI sample for the risk aversion parameter and possibly inequality aversion. An explanation for the better fit of the competitive preferences model in the CID sample is that this sample includes only subjects who sought social information. Since our CID sample is restricted to socially curious subjects, it contains a greater proportion of subjects with competitive preferences (over 60%, as per Table 10) than the population as a whole, as represented in BDOCI (around 45%, as per Table 4).

We find significant evidence of social curiosity. When social information is free, it is sought 90% of the time. When it is costly, the percentage drops to 30% in CID, where social information can be instrumental for the subject's investment decision. This drops to between around 10 and 20% in tasks where social curiosity is not directly instrumental for the investment decision in the same task. We acknowledge two qualifications to these results. First, the sharp increase in information seeking between DOCI and BDOCI suggests that some subjects may have sought social information as they were curious to know whether their guesses in the belief elicitation task were correct or not. They would only have learned this at the end of the experiment if the task was picked for payment. Second, we cannot rule out that, even in CDI, DCI and DOCI, subjects may have sought social information to help them make investment decisions in later tasks. We aimed to minimize this by using a perfect strangers matching protocol. Nevertheless, if subjects engaged into this behavior, as the experiment progresses, there should be less social curiosity particularly when this is costly, and indeed we would not expect any in the last round. While we have a downward trend in social information choice rate when this is costly, it is still just short of 10% in the last round (Figure 4). One problem in interpreting Figure 4, however, is that, because there are only 5 times out of 16 rounds (round 2-17) where there is an option to seek social information, the trend may be confounded by when each individual subjects actually faced information. Online appendix 2.1 constructs a variable called SI (for Social Information) Option, which is equal to 1 the first time a subject is given the choice to seek social information, 2 the second time a subject is given this choice, and so on up to 5. For each task, we can then compare subjects who face this given task the first time they have the choice to get social information, with subjects who face this given task the second time they have this choice, and so on. Social curiosity that is instrumental for future tasks would then predict, when social information is costly, a clear negative trend between the social curiosity rate and SI Option for each task. There is only evidence for this trend in BDOCI, where subjects appear initially additionally curious to learn the outcome of their lottery, whereas they are less so if facing this task later on. Overall, there appears to be a residual of non-instrumental social curiosity.

We find that subjects without competitive preferences still opted to receive social information about half of the time. When social information is free, any ε social curiosity would be sufficient to lead subjects to seek social information. When it is costly, there may be residual sources of social curiosity such as inequality aversion or, as noted for BDOCI, the desire to know whether one's guess about the co-participant's investment decision is correct.

We have also presented two tests for social regret. First, DI only differs from ID in providing the social information after rather than before the investment decision, and we did not find that it has a lower

level of investment, which it should do if the SM weighs the prospect of negative surprises due to social regret more than she does positive surprises. Second, in DOCI, subjects learn about whether they have won or lost the lottery before deciding whether to get social information, and we can therefore test whether those who lost the lottery avoid seeking social information to avoid the higher likelihood of suffering the pain from finding they are behind. We do not find that this is the case. Nevertheless, we recognize that we do not test for social regret within our theoretical framework, other than insofar as the idea of social regret is captured by that of social loss aversion. This could also be a promising area for future research.

Our parametric modeling relied on a single risk aversion parameter and a single social preference parameter within a common framework. For example, our social loss aversion model replicated the key features of reference-dependent models by combining a standard risk aversion parameter with a social preference parameter applicable only in the domain of social losses relative to the reference point determined by the (expected) income of the co-participant.

A generalization of the BO model proved natural as a continuously differentiable, non-linear, single-parameter social preference model benchmark, and thus preferable to Fehr and Schmidt (1999) in our setting. How to combine the BO model with a risk aversion parameter was another key choice we made. For tractability, our framework retains separability between the self-interest component and the social preference component of the utility function but scales both components according to a constant CRRA r parameter. As previously noted, having risk aversion embedded in the social preference component enables us to predict that competitive preferences are socially curious (if $r < 2$ and the price of social information is not too high). Our experimental setup constrained us to a single parameter for both components. We appreciate that the degree to which agents are risk averse may differ in relation to the two, and see this as another avenue for future research. We note that the somewhat related research on risky decision making on behalf of others is not clear about whether subjects change their risk taking when making decisions on behalf of others, and if so in what direction: see a recent summary of results in Eriksen et al. (2020), who find evidence of inconsistency depending on the risk elicitation method used. We would expect greater consistency in our setting as subjects make risky choices about themselves, which are likely to rely on better defined (if socially embedded) preferences than when making risky choices on behalf of others.

While we explained in the introduction why we preferred the GP method over the 'multiple price list' method, in our setting with on average profitable investment, this does not differentiate between risk neutral and risk loving agents. While a natural starting point given the predominance of risk aversion in experimental laboratory settings, we recognize that this potentially limits the generalizability of our

findings to natural world settings where risk taking cannot be explained by risk aversion, such as gambling. Extending our work to such settings could be an interesting avenue of future research. As, it would be explore the extent to which our results would replicate if an experimental loss frame rather than an experimental gain frame is employed.

Our estimates show that in our setting close to 50% of subjects exhibit competitive preferences, and that this is both about outcomes and about actions. We would expect the predictive power of the two models will depend on what information is provided and how it is provided. In natural world settings which mirror our setup, observers may note behavior somewhat akin to that from emerging social norms. Based on our evidence, this is not the cause of behavior – i.e. it is not due to people actually wanting to adhere to the norm (behavioral conformism) – but rather the norm is the result of competitive preferences.[19]

The importance of relative concerns as encapsulated by competitive preferences fits into a broader and long-standing literature on its importance in a number of other economic environments (e.g., Duesenberry, 1949; Bagwell and Bernheim, 1995; Mui, 1995; Clark et al., 2008; Zizzo, 2008; Charness et al., 2014; Kebede and Zizzo, 2015; Breza et al., 2017). Whether it should be encouraged or not (e.g., via the provision of selective social information, or via facilitating or hindering social curiosity) clearly depends on the policy desirability or undesirability of having higher level of the risk taking activity which the psychological competition is about: compare the desirability of higher levels of innovative and entrepreneurial risk taking with the undesirability of not wearing a face mask in a COVID-19 pandemic hotspot area.

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[19] See Clark and Oswald (1998) for a competitive preferences model that, under specific conditions, has a similar property of generating behavioral social norms, albeit in a deterministic setting.

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Online Appendix

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A1: Instructions

Instructions

This is an experimental session about decision making. Please read these instructions fully and carefully, as they will help you to understand this session correctly. In this session, **your earnings will only depend on a combination of luck and the choices you make**; they do not depend on the choices made by anyone else**.** Your identity will remain anonymous. You will indicate your decisions directly on the computer. There are neither good nor bad answers.

From now and until the end of the session, we ask you to switch off your mobile devices and remain silent. Should you have any questions, please raise your hand and a monitor will come to answer your questions privately.

We will read the instructions aloud and ask you to complete a comprehension questionnaire to ensure you correctly understood them. Once all participants have completed the questionnaire, the session will begin.

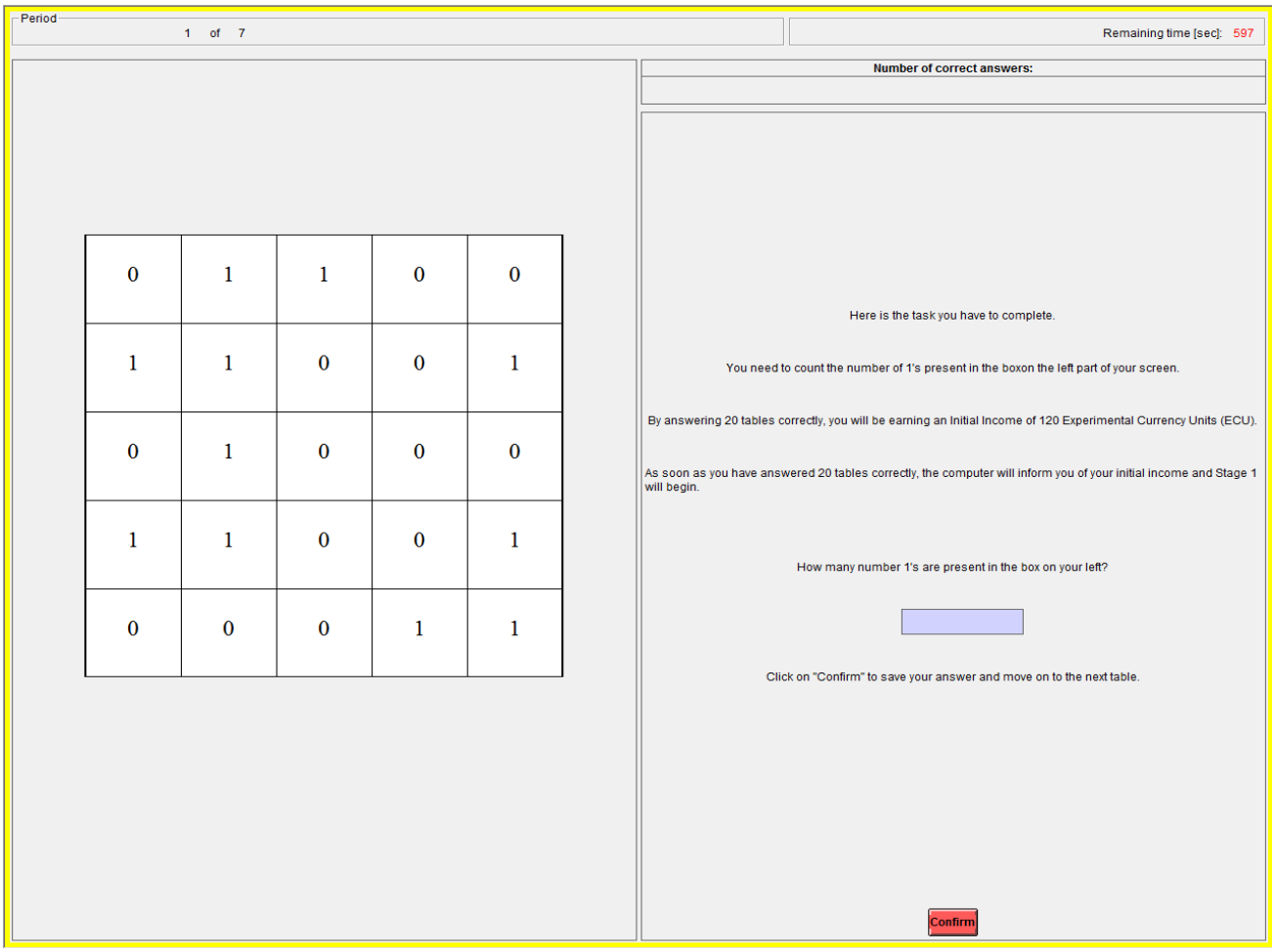
Overview of the experimental session

This session is made of an *initial task*, *three stages* (named **Stage 1**, **Stage 2** and **Stage 3**), and ends with a *final questionnaire*. At the start of each stage you will be given additional instructions. Also, from time to time you will be asked to complete comprehension questions to ensure your understanding of the activities involved in the current stage.

Stage 1 has one decision making period, Stage 2 has sixteen decision making periods and Stage 3 again only one. At the end of this session, the computer will randomly select one period, and your period earnings (that is, your earnings from that period, as defined in more detail later) will be converted into pounds, according to the following exchange rate: 1ECU = £0.10 (10 pence). Therefore, you should think carefully about your decisions.

Initial Task

At the beginning of this session, you are asked to count the number of 1 in a series of tables. The figure below shows the screen you will use.



The left part of the screen displays the table. You are asked to indicate the number of 1's in the box located on the right part of the screen (there are 11 1's in this example). Then click on the button "*Confirm*" to save your choice and move to the next table.

You need to answer **20 tables** correctly in order to be allowed to move to the Stage 1. In addition, by answering 20 tables correctly, you will be earning an ***Initial Income*** **of 120 Experimental Currency Units (ECU)** that you will be able to use in the next stages. As soon as you answer 20 tables correctly, the computer will inform you about your income and Stage 1 will begin.

Stage 1

Stage 1 consists of one period, which has the following steps:

1. You receive the income you earned in the initial task (i.e. your initial income).
2. You can invest any amount from 0 ECU up to and including 90 ECU in a lottery. Any amount you invest in the lottery will be tripled with a probability of 50% or will be lost with a probability of 50%.
3. The computer then proceeds to the random draw of the lottery and informs you about your income, the amount you invested in the lottery, the amount you obtained from the lottery, and your period earnings.

Your period earnings are determined according to the formula below:

$$Period\ Earnings\ =\ Intitial\ Income\ -\ Amount\ invested\ in\ Lottery\ +\ Lottery\ Outcome$$

After all participants in your group have gone through Stage 1, Stage 2 begins.

Stage 2: Instructions FREE

Stage 2 consists of 16 periods. In each period you will have to decide whether to invest some of your income in a lottery, as in Stage 1.

In Stage 2, there are two roles: **First Mover** and **Second Mover**. The First Mover decides first how much to invest in the lottery and the Second Mover decides second. In each period, a First Mover will be paired to a Second Mover selected at random. You will be a First Mover for half of the periods and a Second Mover for the remaining periods. The order in which you will be a First Mover or Second Mover is also determined randomly. At the start of each period you will be informed whether you are a First Mover or a Second Mover and you will be provided with more details for that period. At the start of some periods you will be asked comprehension questions on your computer screen.

A period consists of the following steps:

1. At the beginning of each period, both the First Mover and Second Mover receive the income earned in the initial task.
2. First Movers take their investment decision. Specifically, the First Mover can invest any amount from 0 ECU up to and including 90 ECU. Any amount they invest in the lottery will be tripled with a probability of 50% or will be lost with a probability of 50%. The computer then proceeds to the random draw of the lottery and informs First Movers about their income, the amount they invested in the lottery, the amount they obtained from the lottery and their period earnings.
3. Afterwards, it is the turn of Second Mover's to take their investment decision. Specifically, Second Movers can decide to invest any amount from 0 ECU up to and including 90 ECU. Any amount they invest in the lottery will be tripled with a probability of 50% or will be lost with a probability of 50%. The computer then proceeds to the random draw of the lottery and informs Second Movers about their income, the amount they invested in the lottery, the amount they obtained from the lottery and their period earnings.

At the beginning of each period, Second Movers will be informed about whether they receive, or whether there is the possibility of receiving, information regarding the First Mover they are matched with, in that period. Depending on the period, Second Movers might receive information regarding the First Mover's income, the amount he or she invested in the lottery and obtained from the lottery, and his or her period earnings. First Movers **never** get to know whether Second Movers receive, or have the possibility of receiving, this information about them in any given period. As a Second Mover you are never matched with the same participant twice. Similarly, as a First Mover, you are never matched with the same participant twice.

Your period earnings are determined according to the formula below:

$$Period\ Earnings\ =\ Initial\ Income\ -\ Amount\ invested\ in\ Lottery\ +\ Lottery\ Outcome$$

After all participants in your group have gone through Stage 2, Stage 3 begins.

Stage 2: Instructions WITH PRICE

Stage 2 consists of 16 periods. In each period you will have to decide whether to invest some of your income in a lottery, as in Stage 1.

In Stage 2, there are two roles: **First Mover** and **Second Mover**. The First Mover decides first how much to invest in the lottery and the Second Mover decides second. In each period, a First Mover will be paired to a Second Mover selected at random. You will be a First Mover for half of the periods and a Second Mover for the remaining periods. The order in which you will be a First Mover or Second Mover is also determined randomly. At the start of each period you will be informed whether you are a First Mover or a Second Mover and you will be provided with more details for that period. At the start of some periods you will be asked comprehension questions on your computer screen.

A period consists of the following steps:

4. At the beginning of each period, both the First Mover and Second Mover receive the income earned in the initial task.
5. First Movers take their investment decision. Specifically, the First Mover can invest any amount from 0 ECU up to and including 90 ECU. Any amount they invest in the lottery will be tripled with a probability of 50% or will be lost with a probability of 50%. The computer then proceeds to the random draw of the lottery and informs First Movers about their income, the amount they invested in the lottery, the amount they obtained from the lottery and their period earnings.
6. Afterwards, it is the turn of Second Mover's to take their investment decision. Specifically, Second Movers can decide to invest any amount from 0 ECU up to and including 90 ECU. Any amount they invest in the lottery will be tripled with a probability of 50% or will be lost with a probability of 50%. The computer then proceeds to the random draw of the lottery and informs Second Movers about their income, the amount they invested in the lottery, the amount they obtained from the lottery and their period earnings.

At the beginning of each period, Second Movers will be informed about whether they receive or whether there is the possibility of receiving, information regarding the First Mover they are matched with, in that period. Depending on the period, for the price of 10 ECU, Second Movers might receive information regarding the First Mover's income, the amount he or she invested in the lottery and obtained from the lottery, and his or her period earnings. First Movers **never** get to know whether Second Movers receive, or have the possibility of receiving, this information about them in any given period. As a Second Mover you are never matched with the same participant twice. Similarly, as a First Mover, you are never matched with the same participant twice.

Your period earnings are determined according to the formula below:

$$Period\ Earnings = Initial\ Income - Amount\ invested\ in\ Lottery + Lottery\ Outcome - (if\ applicable)\ Price\ of\ Information$$

After all participants in your group have gone through Stage 2, Stage 3 begins.

Stage 3

Stage 3 is identical to Stage 1. As in Stage 1, you are not paired with another participant and there is only one period which has the following steps:

1. You receive the income you earned in the initial task (i.e. your initial income).
2. You can invest any amount from 0 ECU up to and including 90 ECU to a lottery. Any amount you invest in the lottery will be tripled with a probability of 50% or will be lost with a probability of 50%.
3. The computer then proceeds to the random draw of the lottery and informs you about your income, the amount you invested in the lottery, the amount you obtained from the lottery, and your period earnings.

Your period earnings are determined according to the formula below:

$$Period\ Earnings\ =\ Initial\ Income\ -\ Amount\ invested\ in\ Lottery\ +\ Lottery\ Outcome$$

After all participants in your group have gone through Stage 3, you will be provided with the final questionnaire. Please follow the instructions on your computer screen.

COMPUTERISED INSTRUCTIONS

Instructions Screens

GAMES 1-8 (FIRST MOVERS ONLY)

In this period, you are a First Mover.

The Second Mover may or may not receive information or choose to receive information about the amount you invested in the lottery, the amount obtained from the lottery and your initial income and period's earnings. If the Second Mover receives this information, this will be either before or after he or she makes his or her investment decision.

GAME 1 (SECOND MOVERS ONLY)

In this period, you receive no information about the First Mover you have been paired with.

GAME 2 (SECOND MOVERS ONLY)

In this period, you receive some information about the First Mover in addition to the information about you.

Price Treatment: In this period, for the price of 10 ECU, you receive some information about the First Mover in addition to the information about you.

More precisely, **before** investing in the lottery and **before** learning about its outcome, you will be informed about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.

GAME 3 (SECOND MOVERS ONLY)

In this period, you receive some information about the First Mover in addition to the information about you.

Price Treatment: In this period, for the price of 10 ECU, you receive some information about the First Mover in addition to the information about you.

More precisely, **after** investing in the lottery and **before** learning about its outcome, you will be informed about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.

GAME 4 (SECOND MOVERS ONLY)

In this period, you can choose to receive some information about the First Mover in addition to the information about you.

Price Treatment: In this period, for the price of 10 ECU, you can choose to receive some information about the First Mover in addition to the information about you.

More precisely, **before** investing in the lottery and **before** learning about its outcome, you will be offered the choice to be informed straight away about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.

GAME 5 (SECOND MOVERS ONLY)

In this period, you can choose to receive some information about the First Mover in addition to the information about you.

Price Treatment: In this period, for the price of 10 ECU, you can choose to receive some information about the First Mover in addition to the information about you.

More precisely, **before** investing in the lottery and **before** learning about its outcome, you will be offered the choice to be informed about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.

If you make this choice, you will receive this information **after** investing in the lottery and **before** learning about its outcome.

GAME 6 (SECOND MOVERS ONLY)

In this period, you can choose to receive some information about the First Mover in addition to the information about you.

Price Treatment: In this period, for the price of 10 ECU, you can choose to receive some information about the First Mover in addition to the information about you.

More precisely, **after** investing in the lottery and **before** learning about its outcome, you will be offered the choice to be informed straight away about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.

GAME 7 (SECOND MOVERS ONLY)

In this period, you can choose to receive some information about the First Mover in addition to the information about you.

Price Treatment: In this period, for the price of 10 ECU, you can choose to receive some information about the First Mover in addition to the information about you.

More precisely, **after** investing in the lottery and **after** learning about its outcome, you will be offered the choice to be informed straight away about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.

GAME 8 (SECOND MOVERS ONLY)

In this period, you can choose to receive some information about the First Mover in addition to the information about you.

Price Treatment: In this period, for the price of 10 ECU, you can choose to receive some information about the First Mover in addition to the information about you.

More precisely, **after** investing in the lottery and **after** learning about its outcome, you will be offered the choice to be informed straight away about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.

Choice-Before Screens

Game 4

Before your investment decision, would you like to receive information about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings?

Price Treatment: Before your investment decision, for the price of 10 ECU, would you like to receive information about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings?

Game 5

After your investment decision, would you like to receive information about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings?

Price Treatment: After your investment decision, for the price of 10 ECU, would you like to receive information about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings?

Choice-After Screens

Game 6

Would you like to receive information about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings?

Price Treatment: For the price of 10 ECU, would you like to receive information about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings?

During Results Screens

Game 7 & 8

Would you like to receive information about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings?

Price Treatment: For the price of 10 ECU, would you like to receive information about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings?

Special Guessing Task

We will, however, begin this period with a special guessing task. You are asked to guess how much the First Mover has invested in the lottery (between the minimum of 0 ECU and the maximum of 90 ECU). You will earn a bonus of **30 ECU** if you get this precisely right, and of **5 ECU less** for each point that your guess is off the mark. If your guess is off the mark for more than 5 points, you will lose the opportunity to earn this bonus. Therefore, you should think carefully before you decide.

Example: if you guess 51 but the First Mover invested 56 ECU, you would earn a bonus of 5 ECU (that is, 30 ECU bonus *minus* 5 x 5 = 25 ECU of penalty).

This special guessing task earnings are not part of your period earnings (that is, the earnings from your initial endowment of 90 ECU and from the lottery investment outcome). Instead, at the end of the experiment, your special guessing task earnings will be paid to you (at the standard 1ECU = £0.10 rate) in addition to your period earnings, with one exception.

The exception is that a bonus will not be paid if the computer randomly selects this period for payment in terms of period earnings. In this case (that is, if you are paid the period earnings for this period), the special guessing task earnings will not be converted into pounds.

This is the **only** special guessing task you will face in this session. There will **not** be another special guessing task after this period.

Social Preference Task

In the following questionnaire you will be asked to make **ten decisions. In each of the ten decision problems** you are asked to decide between **two alternatives** which are called **LEFT** and **RIGHT.** Each alternative implies earnings for you and another person, your co-participant. At the end of the questionnaire, one of the ten decision problems will be randomly chosen by the computer for payment to you and your co-participant.

In addition, you will be matched with a different participant from this session who will be asked to make the same ten decisions. Depending on his/her choices and which decision problem the computer will randomly select, you will receive some additional earnings.

Your final questionnaire earnings will be added to your earnings from the previous stages of this experiment.

-COMPREHENSION QUESTIONNAIRE-

(Computerized in zTree)

Variant	**D**	**ID (Exog. Ante – Before Decision)**	**DI (Exog. Post – Before Decision)**	**CID (Endog. Ante – Before Decision)**	**CDI (Endog. Post – Before Decision)**	**DCI (Endog. Post – After Decision)**	**DOCI (Endog. Post – After Results)**	**BDOCI (Endog. Post – After Results) + Beliefs**
SI Type		Exogenous (SI by default)	Exogenous (SI by default)	Endogenous (SI by option)	Endogenous (SI by option)	Endogenous (SI by option)	Endogenous (SI by option)	Endogenous (SI by option)
First Mover	No Info	No Info	No Info	No Info	No Info	No Info	No Info	No Info
Second Mover	No Info	Social Information before investing & before decision	Social Information after investing & before decision	Social Information before investing & before decision	Social Information after investing & before decision	Social Information after investing & after decision	Social Information after investing & after results	Social Information after investing & after results

Question	Initial Task	Stage 1	Beginning of Stage 2	**D**		**ID**		**DI**		**CID**		**CDI**		**DCI**		**DOCI**		**BDOCI**	
				FM	SM	FM	SM	FM	SM	FM	SM	FM	SM	FM	SM	FM	SM	FM	SM
Q1	X																		
Q2	X																		
Q3		X																	
Q4		X																	
Q5		X																	
Q6			X																
Q7			X																
Q8			X																
Q9				X*		X*		X*		X*	X*	X*		X*		X*		X*	
Q10					X														
Q11							X												
Q12									X										
Q13																			
Q14													X						
Q15															X				
Q16																	X		X
Q17																			X

* Given only in first period that participant is First Mover. Note that First Mover never knows in which variant he/she is playing in periods 2-17, so these periods are all identical insofar as he/she is concerned.

QUESTIONS

QUESTIONS REGARDING INITIAL TASK AND PAYMENT

1. Question: How many tables do you need to solve correctly in order to earn 120 ECU?
a) 1
b) 20
c) 30

2. Question: How many periods will be paid out for the experiment?
a) All periods
b) Only period 1
c) Only one randomly selected period

QUESTIONS REGARDING STAGE 1

3. Question: Up to what amount can you invest in the lottery?
a) 40 ECU
b) 90 ECU
c) 120 ECU

4. Question: If you invest 20 ECU in the lottery, what will your earnings be in Stage 1?
a) 60 ECU (20 x 3) with a 50% probability or 0 ECU with a 50% probability.
b) 110 ECU (120 – 70 +20 x 3) with a 50% probability or 50 ECU (120 – 70 + 20 x 0) with a 50% probability.
c) 160 ECU (120 – 20 + 20 x 3) with a 50% probability or 100 ECU (120 – 20 + 20 x 0) with a 50% probability.

5. Question: What information will the computer give you after your decision on how much to invest in the lottery?
a) The amount you invested in the lottery and the amount you obtained from the lottery.
b) The amount you obtained from the lottery.
c) The amount you invested in the lottery, the amount you obtained from the lottery and your period earnings.

QUESTIONS REGARDING STAGE 2

6. Question: Which of the following statements is correct?
a) You are matched randomly with an experimental participant at the beginning of each period.
b) You are guaranteed to be matched always with the same experimental participant.
c) You are not matched with anyone else in Stage 2.

7. Question: How many periods are there in Stage 2?
a) 1 period.
b) 5 periods.
c) 16 periods.

8. Question: In Stage 2, how many times will you be a second mover?
a) Only once.
b) Eight times.
c) Once you are informed you are a first mover, you keep the role up to the last period of Stage 2.

FIRST MOVER QUESTION

9. Question: You are a First Mover. Which of the following statements is true?

a) You may or may not be informed about the amount you invested in the lottery, the amount you obtained from the lottery, your initial income and period earnings.
b) You are never informed about the amount you invested in the lottery, the amount you obtained from the lottery, your initial income and period earnings.
c) At the end of this period and after the Second Mover has made his or her decision, you will be informed about the amount the Second Mover you are matched with invests in the lottery, the amount he or she obtains from the lottery, his or her initial income and period earnings.
d) In this period, you are never informed about the amount the Second Mover you are matched with invests in the lottery, the amount he or she obtains from the lottery, his or her initial income and period earnings.

SECOND MOVER QUESTIONS – Free Treatment

10-14. Question: You are a Second Mover. Which of the following statements is true?

a) You may or may not be informed about the amount you invested in the lottery, the amount you obtained from the lottery, your initial income and period earnings.
b) You are never informed about the amount you invested in the lottery, the amount you obtained from the lottery, your initial income and period earnings.
c) In this period and before making your investment decision, you will be informed or you can choose to be informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.
d) In this period and after making your investment decision, you will be informed or you can choose to be informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.
e) In this period, you are never informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.

15-16. Question: You are a Second Mover. Which of the following statements is true?

a) You may or may not be informed about the amount you invested in the lottery, the amount you obtained from the lottery, your initial income and period earnings.
b) In this period, after investing in the lottery and before you learn its outcome, you will decide whether you would like to be informed about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.
c) In this period after investing in the lottery and learn its outcome, you will decide whether you would like to be informed about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.
d) In this period and before making your investment decision, you will be informed or you can choose to be informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.

e) In this period, you are never informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.

17. Question: If you guessed that the First Mover invested in the lottery 40 ECU but the First Mover's investment was (i) 39 ECU or (ii) 84 ECU what will your earnings in ECU be from the special guessing task?

a) (i) 39 ECU, (ii) 0 ECU
b) (i) 39 ECU, (ii) 84 ECU
c) (i) 25 ECU, (ii) 5 ECU
d) (i) 25 ECU, (ii) 0 ECU

SECOND MOVER QUESTIONS – Price Treatment

10-12. Question: You are a Second Mover. Which of the following statements is true?

a) You may or may not be informed about the amount you invested in the lottery, the amount you obtained from the lottery, your initial income and period earnings.
b) You are never informed about the amount you invested in the lottery, the amount you obtained from the lottery, your initial income and period earnings.
c) In this period and before making your investment decision, you will be informed or you can choose to be informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.
d) In this period and after making your investment decision, you will be informed or you can choose to be informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.
e) In this period, you are never informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.

13-14. Question: You are a Second Mover. Which of the following statements is true?

a) You may or may not be informed about the amount you invested in the lottery, the amount you obtained from the lottery, your initial income and period earnings.
b) You are never informed about the amount you invested in the lottery, the amount you obtained from the lottery, your initial income and period earnings.
c) In this period and before making your investment decision, you can choose, at the price of 10 ECU, to be informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.
d) In this period and after making your investment decision, you can choose, at the price of 10 ECU, to be informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.
e) In this period, you are never informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.

15-16. Question: You are a Second Mover. Which of the following statements is true?

a) You may or may not be informed about the amount you invested in the lottery, the amount you obtained from the lottery, your initial income and period earnings.

b) In this period, after investing in the lottery and before you learn its outcome, you can choose at the price of 10 ECU to be informed about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.
c) In this period after investing in the lottery and learn its outcome, you can choose at the price of 10 ECU to be informed about the amount invested by the First Mover in the lottery, the amount obtained by the First Mover from the lottery and the First Mover's initial income and period earnings.
d) In this period and before making your investment decision, you can choose at the price of 10 ECU to be informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.
e) In this period, you are never informed about the amount the First Mover you are matched with invested in the lottery, the amount he or she obtained from the lottery, his or her initial income and period earnings.

18. Question: If you guessed that the First Mover invested in the lottery 40 ECU but the First Mover's investment was (i) 39 ECU or (ii) 84 ECU what will your earnings in ECU be from the special guessing task?

a) (i) 39 ECU, (ii) 0 ECU
b) (i) 39 ECU, (ii) 84 ECU
c) (i) 25 ECU, (ii) 5 ECU
d) (i) 25 ECU, (ii) 0 ECU

A2: Additional Econometric Analysis

A2.1: Regressions on Time Trends

As noted in section 5, we generated the SI (=Social Information) Option variable to appropriately capture the effect of choosing to observe information over time, with a focus on when this is costly. SI Option is a categorical variable that takes the value of 1 the first time a subject is given the opportunity to choose observe social information and it increases every subsequent time (s)he is given a similar opportunity (up to the maximum of 5).

Table A2.1 reports Probit regressions on the choice of social information for each of our games when this is costly, including SI Option as an explanatory variable. With the exception of BDOCI, which appears driven by SI Option = 1, we find no significant evidence of a negative relationship between Choice and SI Option.

An interesting and plausible secondary finding is that our measure of sensitivity to social pressure consistently predicts greater social information seeking in all of the five tasks.

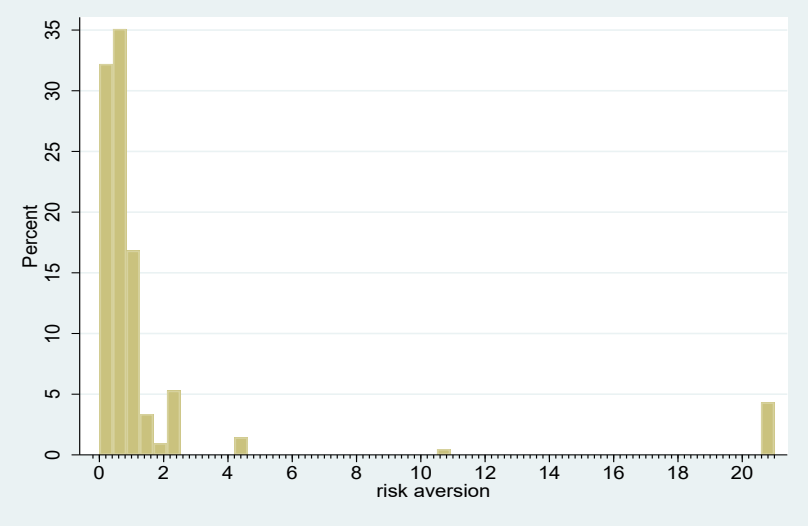
Table A2.1: Probit regressions on when costly social information was chosen

Choice	CID	CDI	DCI	DOCI	BDOCI
SI Option	-0.042 (0.03)	-0.052 (0.03)	-0.033 (0.02)	0.012 (0.01)	-0.045** (0.02)
Investment	-0.001 (0.00)	-0.001 (0.00)	0.001 (0.01)	0.001 (0.00)	-0.001 (0.00)
Gender	0.111 (0.09)	-0.011 (0.08)	0.212**** (0.04)	0.091 (0.07)	0.104 (0.09)
SDS	0.038** (0.01)	0.027** (0.01)	0.022* (0.01)	0.029*** (0.01)	0.035** (0.01)
Wald χ^2	94.63	14.92	76.27	23.84	21.4
Obs	112	112	112	112	112

Notes: *** Significant at 1% level; ** significant at 5% level; * significant at 10% level. Marginal effects are reported. Robust standard errors in parentheses. Investment levels censored at 0 and 90.

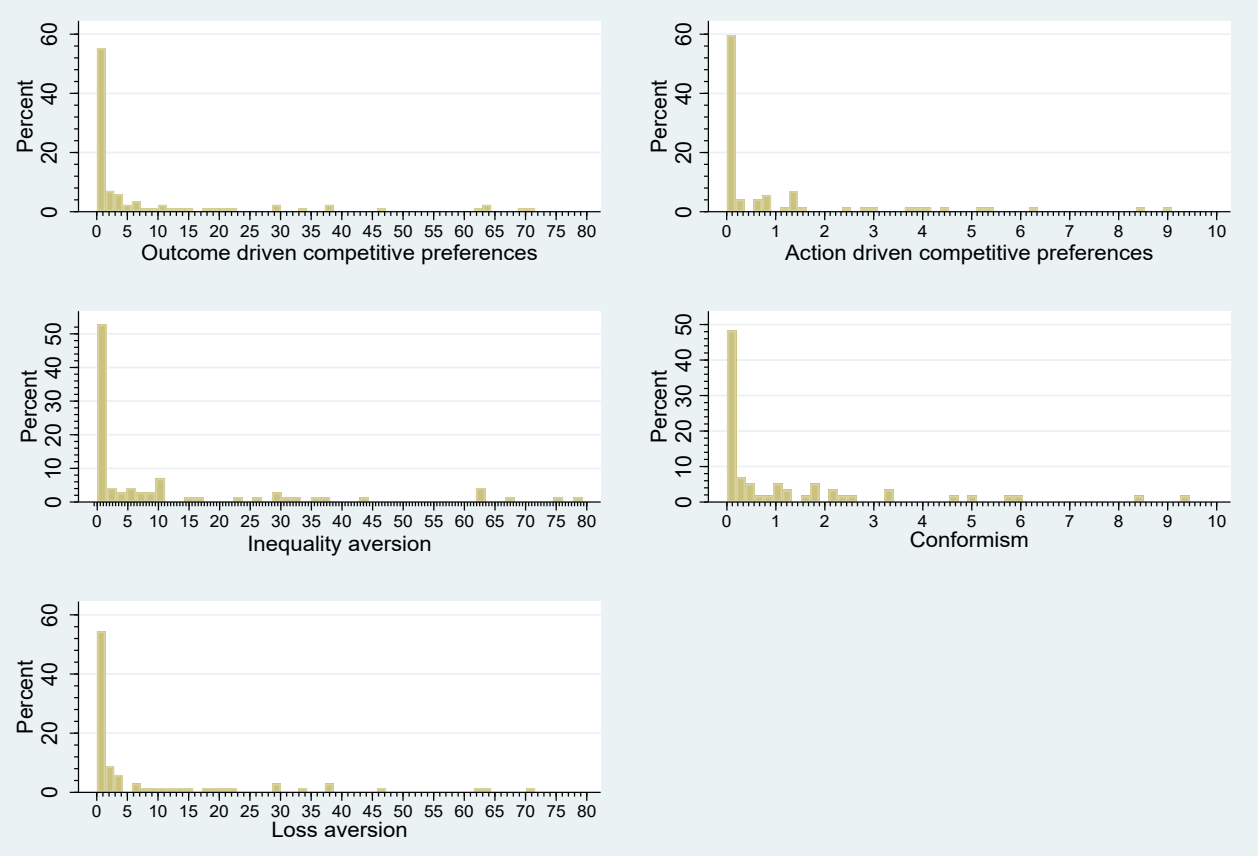
A2.2: Histograms on structural parameters (*r, alpha*)

Figure A1: *risk aversion*



Notes: As r approaches infinity when investment 0, we opted for setting $r = 21$ when subjects chose to invest nothing in the lottery task. An $r = 21$, would truly represent an agent who is willing to invest $\frac{1}{10^5}$ of their endowment to a lottery.

Figure A2: *Structural estimations of alpha by model*



Notes: Cases where $a = 0$ and extreme outliers representing less than 5% of the distribution are excluded.