Incentives and Strategic Behaviour: An Experiment

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Abstract

How and why do incentive levels affect strategic behaviour? This paper examines an experiment designed to identify the causal effect of scaling up incentives on choices, beliefs, and response times in dominance-solvable games. Higher incentives increase action sophistication and decrease mistake propensity, while beliefs become more accurate, and response times longer. We provide evidence that higher incentives increase cognitive effort, as proxied by longer response times, which in turn is associated with improved performance and predicts choice sophistication and belief accuracy. Overall, the data lend support to both payoff-dependent mistakes and costly reasoning models.

Keywords: Incentives; Cognitive Cost; Sophistication; Response Times; Level-k; Quantal Response; Belief Formation; Sequential Sampling.
JEL Classifications: C72, C92, D83, D84, D91.

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1. Introduction

Deviations from Nash equilibrium and rationalisable behaviour are well-documented, both within and across games. Within-game evidence suggests systematic departures from Nash predictions, including substantial proportions of non-rationalisable and even dominated choices. Across games, existing evidence largely focuses on how increasing *relative* incentives for a player to choose a given action increases its observed frequency.[1] This evidence has spurred the development of new behavioural models for strategic settings, incorporating limited reasoning ability, as in level-k (Nagel, 1995; Stahl and Wilson, 1995) and cognitive hierarchy (Camerer et al., 2004), mistakes as in quantal response equilibrium (McKelvey and Palfrey, 1995), or face cognitive costs, as in endogenous depth of reasoning models (Alaoui and Penta, 2016) and sequential sampling equilibrium (Gonçalves, 2024).

Given the cognitive demands of strategic decision-making — requiring individuals to understand the environment, anticipate others' actions, and determine their own best response — incentive levels can significantly impact behaviour. In non-strategic decisions, higher incentives or stakes typically increase effort and improve choices in simple problems (Dean and Neligh, 2022; Caplin et al., 2020).[2] In strategic settings, what makes a choice 'better' depends on others' behaviour, which renders the effect of incentives on behaviour ambiguous.

Existing models suggest two mechanisms through which incentive levels may operate on behaviour. On the one hand, higher incentives make mistakes more costly and, consequently, more infrequent — as in quantal response equilibrium. On the other hand, higher incentives may also encourage greater cognitive effort, leading to different beliefs about others and thus different choices — as in costly reasoning models.

Despite this, the literature lacks clearly identified evidence of how incentive levels affect strategic behaviour and of which mechanisms are at play. While increasing overall incentives (scaling up payoffs) can lead to greater action sophistication (e.g. McKelvey and Palfrey, 1992; Rapoport et al., 2003; Camerer, 2003), it remains unclear how much of this effect is attributable to a player's own incentives, their opponents' reaction to the player's incentives, or the opponents' incentives, much less what mechanisms drive these changes.

This paper experimentally examines the causal effect of incentive levels on both choices and beliefs in dominance-solvable games. Focusing on dominance solvable games, we show that higher own incentive levels lead to more sophisticated behaviour and a higher best-response rate to reported beliefs. Higher own incentives also lead to more accurate beliefs being formed. Finally, higher incentives significantly increase response time, which we find to be positively associated with expected

[1] See, among many others, McKelvey and Palfrey (1992), Goeree and Holt (2001) and Costa-Gomes and Weizsäcker (2008). Camerer (2003) presents on early overview of experimental evidence.

[2] The evidence is nuanced though; for instance, recent evidence by Enke et al. (2023) shows that higher incentive levels does increase response time — a proxy for exerted effort — but performance increases only in simple enough tasks.

payoffs, as well as both action and belief sophistication.

Our design separately identifies the effects of own and opponent's incentive levels using the replacement method (Alaoui et al., 2020). In short, payments are binarised and we use two baseline treatments where participants and opponents have identical incentives (high or low), and two further treatments where participants face opponents from the baseline treatments but with different incentives. This allows us to vary a participant's own incentives while holding their opponent's choices and incentives fixed, and resolving uncertainty about opponents' incentives.[3] Participants' actions do not affect their opponents' payoffs, maintaining symmetric strategic incentives across treatments and minimising the influence of other-regarding preferences. Incentive levels are manipulated by randomly assigning participants to high or low bonus treatments, scaling absolute incentives without affecting relative incentives.

We consider two two-player dominance-solvable games in which actions are linearly ordered by iterated dominance. One game is arguably 'simpler' than the other in that it takes fewer steps of iterated elimination of strictly dominated actions to reach the dominance solution. In both games, level-k actions are identified in a manner that is robust to risk attitudes and there are clear comparative statics predictions for logit quantal response equilibrium (uniquely defined), endogenous depth of reasoning, and sequential sampling equilibrium. The games share a number of features with standard dominance-solvable games (such as 11-20, undercutting games, and ring games), which enables us to relate our results to the existing literature. To keep incentives per game high-powered, we focus on initial responses and use a single incentivised round. We then obtain a $2\times2\times2$ between-participant design with random assignment, in which over 800 participants recruited online play only one game and only once.

Our first set of results pertains to choices. We show that higher own incentives increase sophistication and decrease mistakes. Dominated actions are less frequent, and choices become less noisy and stochastically shift towards more sophisticated actions. In line with models of stochastic choice, actions with higher expected payoffs are played more often, and choices become more responsive to payoff differences with a higher scale of incentives. Higher opponents' incentives have a smaller, non-significant effect on choice sophistication.

Our second set of results examines beliefs. With higher incentives, beliefs shift toward predicting more sophisticated actions: participants expect level-1 and level-2 actions being played more often and dominated actions less often — which does happen. Consistently, belief accuracy also increases with higher own incentives. However, while beliefs tend to predict the comparative statics correctly, they do become more biased when opponents' incentives are higher; this is likely because choices by opponents with lower incentives are noisier and closer to uniform, hence easier to predict. Thus,

[3]Specifically, this simple setup not only resolves participants' beliefs about their opponents' incentive level, it also informs them of the incentive level of their opponents' opponents and so on.

own and opponent incentives have opposing effects on belief accuracy.

Our last set of results considers response times, a proxy for cognitive effort. By increasing the marginal benefit to reasoning, own incentive levels may affect beliefs (and therefore choices), as predicted by models in which players engage in a cost-benefit analysis of reasoning such as in endogenous depth of reasoning or in sequential sampling equilibrium. Similarly to existing literature (Caplin et al., 2020; Alós-Ferrer and Buckenmaier, 2021; Frydman and Nunnari, 2023, e.g.), we proxy for cognitive effort by examining response time data and find that higher own incentive levels increase response time by more than 40%. Additionally, longer response times are associated with better empirical performance, that is, higher payoffs.

Finally, we explore how response times relate to both actions and beliefs. We find that, controlling for incentives and individual characteristics, participants who take longer believe their opponents are more sophisticated and choose more sophisticated actions, but don't necessarily hold stronger beliefs that the dominance solution is chosen in games when it is not. In particular, longer response times are associated with believing in a higher frequency of play for the level-1 and level-2 actions, the latter of which corresponds to the modal action in both games regardless of whether it corresponds to the dominance solution (as in the simpler game) or not (as in the more complex game). This is consistent with Alós-Ferrer and Buckenmaier (2021), where longer response times make higher-level choices more likely.

We conclude with a critical discussion of our findings. Our manipulation of incentive levels was financial and we strove to design an experiment and recruit participants for which these were the main motivation. Nevertheless, higher incentive levels should be understood more broadly, extending to the intensity of motivations.[4] The fact that action sophistication and belief accuracy increase in the simpler game, but less so or not at all in the more complex game, suggests that the effect of incentives depends on environmental complexity. This highlights that there are natural limits to the effects of higher incentives: in many cases, no matter how much effort is exerted, arbitrarily high incentives will not lead to 'rational' behaviour. If anything, the Yerkes-Dodson 'law' (Yerkes and Dodson, 1908) would suggest that unfamiliar or extreme levels of incentives can deteriorate performance, as identified by Ariely et al. (2009) and Enke et al. (2023).

Taken together, our results suggest incentive levels increase action sophistication both by increasing the incentive to reason further and form better beliefs and by decreasing the propensity to make mistakes. If the belief very high incentives can lead to outstanding performance has been disputed, our findings caution against the other polar extreme of positing that higher incentives have no impact on behaviour.

[4]Oftentimes stronger financial motivations do crowd out other kinds of incentives, which find no evidence of. In the appendix, we include an examination of other-regarding preferences, which seem to not play a role in our results.

1.1. Related Literature

Our paper contributes to the study of strategic sophistication in games, of how incentives relate to performance and mistakes in games, and of how response time relates to choices.

Strategic Sophistication. There is longstanding evidence that different individuals seem to exhibit different levels of strategic sophistication, which helps explain deviations from Nash equilibrium predictions. This is so in dominance-solvable games — such as beauty contests (Nagel, 1995), undercutting games (Costa-Gomes and Crawford, 2006), and ring games (Kneeland, 2015) — but also in games that are not dominance-solvable (see e.g. Arad and Rubinstein, 2012; Fudenberg and Liang, 2019). Motivated by the observation that the level of strategic sophistication for a given individual is not stable across games (Georganas et al., 2015) and depends on beliefs about the opponents (Agranov et al., 2012; Alaoui et al., 2020), the discussion has since moved toward better understanding the effects of incentives on strategic sophistication, with recent models endogenising this relation (e.g. Alaoui and Penta, 2016, 2022b; Gonçalves, 2024).

Closest to this paper is the recent work by Alaoui et al. (2020), which shows that changing relative incentives so as to make the structure of iterated dominance more salient leads to a first-order stochastic dominance shift of choices toward higher levels of strategic sophistication, as given by the order of rationalisability of a given action. In contrast, this paper keeps relative incentives between actions fixed and examines the effect of incentive level on both choices and beliefs. While there is evidence for greater strategic sophistication due to greater cognitive effort exerted in forming beliefs about the opponents' behavior, we also find that the effect of incentive levels on reducing mistakes is also a major channel that needs to be taken into account.

Incentives and Mistakes. Choices in strategic settings tend to have a dimension of payoff-dependent stochasticity — an idea originating in discrete choice models (Luce, 1959; McFadden, 1974) — and action frequencies are closely related to their associated expected payoffs: those with higher expected payoffs are not always chosen, but they are chosen with higher probability. This monotonicity of choice frequencies with respect to payoffs is the hallmark of quantal response equilibrium (McKelvey and Palfrey, 1995; Goeree et al., 2005) and other models of costly optimisation in games (Mattsson and Weibull, 2002), which originated a wealth of applications — see (Holt et al., 2016) for a survey. In line with the main premise of this class of models, we find evidence for the posited monotonicity in dominance solvable games, with a crucial difference: monotonicity holds considering expected payoffs not according to the objective empirical frequency of actions, but with respect to each participant's reported beliefs. Moreover, although participants do not perfectly best-respond to stated beliefs — as noted in prior work, e.g., Costa-Gomes and Weizsäcker (2008) and Rey-Biel (2009) — we find that a higher own incentive levels sharpens the association between (subjective) expected payoffs and choice frequencies, and participants best-respond more often to their beliefs.

This paper is also related to work relating incentive levels and performance. Recent evidence from individual decision-making problems shows that, Consistent with costly cognition models (Matějka and McKay, 2015; Caplin and Dean, 2015), with higher incentives, people perform better (Dean and Neligh, 2022). However, as discussed above, this effect seems to depend on the complexity of the task and, especially, whether participants face extreme and unfamiliar incentive levels (see, e.g. Ariely et al., 2009; Enke et al., 2023). In strategic settings, higher stakes lead rejection rates close to the subgame perfection prediction of zero in ultimatum games (Andersen et al., 2011), and also seem to entail greater sophistication in centipede games, with fewer 'passes' (McKelvey and Palfrey, 1992; Rapoport et al., 2003), but do not necessarily lead behaviour closer to Nash equilibrium predictions in games with a unique mixed strategy equilibrium (McKelvey et al., 2000; Camerer, 2003, ch. 3). As argued earlier, our contribution relative to these papers is to provide causally identified evidence of the effect of incentive levels on choices, beliefs and response times within a strategic setting.

Response Times in Strategic Settings. Finally, our work is related to a burgeoning literature which studies response time in strategic settings, either using it as a way to classify participants (Rubinstein, 2016), predict choice (Schotter and Trevino, 2021) or strategic sophistication (Alós-Ferrer and Buckenmaier, 2021; D.Gill and Prowse, 2022), or as a proxy for cognitive effort (e.g. Rubinstein, 2007; Proto et al., 2019; Frydman and Nunnari, 2023) (see Spiliopoulos and Ortmann (2018); Clithero (2018) for a review). The most related paper within this is that of Alós-Ferrer and Buckenmaier (2021), who examine response times in beauty contest and different variants of the 11-20 game with a unique mixed strategy Nash equilibrium. The authors find that high levels of sophistication are associated with longer response time and that *distorting* incentives in favor of 'undercutting' lead to smaller numbers — arguably associated with higher sophistication, despite the fact the variants chosen not being dominance-solvable — and to shorter response times. Differently from these studies, we provide clearly identified results on how own and opponents' incentive levels affect response time. Additionally, we provide suggestive evidence of the association between response time and strategic sophistication, relying both on choices and reported beliefs, supporting a mechanism that relates incentives to cognitive effort and this, in turn, affecting belief formation and choices.

2. Framework and Hypotheses

We consider the effect of incentive levels on behaviour in finite simultaneous games. Let $\Gamma_\lambda = \langle I, A, u_\lambda \rangle$ denote a normal-form game, where I is the set of players, A_i the action set for player i, A_{-i} the action profiles of player i's opponents, $A = \times_{i \in I} A_i$ the set of all action profiles, and $u_i : A \to \mathbb{R}$ player i's payoff function. We define $u_\lambda = \{\lambda_i \cdot u_i\}_{i \in I}$, where $\lambda_i > 0$ is a scaling parameter representing player i's incentive level. Payoffs are extended to the space of probability distributions over actions in the usual way. We use $a_i \in A_i$ to denote player i's action and $b_i \in \Delta(A_{-i})$ to denote their beliefs about opponents' actions.

Many models of strategic interaction predict that a player's incentive level has no bearing on observed behaviour. This invariance is not unique to Nash equilibrium. The level-k model (Stahl and Wilson, 1994, 1995; Nagel, 1995), for instance, where level-k players best-respond to level-$(k-1)$ players (with level 0 typically defined as uniform randomisation), is invariant to payoff scaling. This invariance also holds for other behavioural solution concepts, including cognitive hierarchy (Camerer et al., 2004), sampling equilibrium (Osborne and Rubinstein, 1998, 2003), noisy beliefs equilibrium (Friedman, 2022), and various equilibrium concepts featuring uncertainty aversion (Dow and Werlang, 1994; Eichberger and Kelsey, 2000; Klibanoff, 1996) or regret aversion (Renou and Schlag, 2010).

In contrast, a separate class of models suggests that higher incentives foster more careful reasoning and sophisticated strategic behaviour. Two classes of models in particular support this insight: models with stochastic mistakes, such as quantal response equilibrium (McKelvey and Palfrey, 1995), and models with costly reasoning, such as endogenous depth of reasoning (Alaoui and Penta, 2016, 2022a) and sequential sampling equilibrium (Gonçalves, 2024). Models with stochastic mistakes posit that players' choices are subject to stochastic payoff disturbances (as in models of costly precision and payoff disturbances, e.g., McFadden 1974; Mattsson and Weibull 2002; Fudenberg et al. 2015), resulting in noisy best responses: while mistakes occur, actions with higher expected payoffs are chosen more frequently (Goeree et al., 2005). Models with costly reasoning assume that beliefs about opponents are derived from a costly reasoning process.[5] Higher incentives increase the cost of mistakes in the former class of models, leading to less noisy best responses. In the latter, they induce players to exert greater cognitive effort, resulting in different beliefs and choices.

Our first hypothesis concerns the effect of incentives on action sophistication, which we define relying on rationalisability. Recall that an action is k-rationalisable if there is a distribution over $(k-1)$-rationalisable actions of opponents against which it is a best response, while all actions are 0-rationalisable; we denote the set of k-rationalisable actions for player i by R_i^k. We say that an action a_i' is **more sophisticated** than another a_i ($a_i' \rhd a_i$) if it iteratively dominates it,[6] that is, if there is k such that $a_i', a_i \in R_i^k$ and $u_i(a_i', a_j) > u_i(a_i, a_j)$ for all $a_j \in R_j^k$. Note that, if a_i is k-rationalisable, then a_i' is **more sophisticated than** a_i only if a_i' is also k-rationalisable.

Given the divergent predictions of existing models, our first hypothesis is:

Hypothesis 1 (Action Sophistication)**.** Action sophistication increases in (a) own incentive level

[5] In one version of endogenous depth of reasoning, players have a path of reasoning based on iterative best responses and they stop reasoning whenever the cost of reasoning exceeds the maximum benefit, given by considering the current tentative action a_i and the maximal gain that could be achieved $\max_{a_i', a_{-i}} u_i(a_i', a_{-i}) - u_i(a_i, a_{-i})$. Sequential sampling equilibrium considers a model of reasoning inspired on sequential sampling models (Forstmann et al., 2016; Fudenberg et al., 2018) taking into account player uncertainty: steps of reasoning correspond to costly noisy signals about others' distribution of actions and players optimally stop reasoning.

[6] Note that in two-player games, actions which are k-rationalisable correspond to those which survive k rounds of maximal iterated deletion of strictly dominated strategies (Pearce, 1984, Lemma 3).

and (b) the opponents' incentive level.

Beyond simply testing Hypothesis 1, we aim to understand the *mechanisms* through which incentive levels affect choices.

One plausible channel is that higher incentives make mistakes more costly, thereby reducing the likelihood of suboptimal actions. This leads to our next hypothesis:

Hypothesis 2 (Mistakes)**.** (a) Best-response rates increase in own incentive level. (b) Actions with higher expected payoff are chosen more often.

Another channel through which incentives may operate is by influencing belief formation. Beliefs about opponents' sophistication can explain the play of non-rationalisable actions. For instance, whether players choose more or less sophisticated actions has been seen to depend on opponent characteristics associated with sophistication, such as chess ratings (Palacios-Huerta and Volij, 2009) or educational background (Agranov et al., 2012; Alaoui et al., 2020). We expect that higher incentives enhance understanding of the game structure, making it more likely that participants consider opponents' payoffs and recognise dominated actions would be less likely to be chosen.

The effect of incentive level on beliefs may depend on whose incentive level changes. Higher opponent incentives may lead to beliefs of greater opponent sophistication, mirroring the pattern observed with changes in relative incentives: when a player's relative incentive to choose an action increases, so does the frequency with which it is chosen, and opponents adjust both their choices and their beliefs accordingly (Ochs, 1995; McKelvey et al., 2000; Goeree and Holt, 2001; Friedman and Ward, 2022). Conversely, higher *own* incentives increases the value of careful reasoning, which may also lead to more accurate beliefs. For instance, given the tendency to underestimate opponent sophistication, higher own incentives could mitigate this misperception. These insights constitute the core of our next hypothesis:

Hypothesis 3 (Belief Sophistication)**.** The belief in opponents' strategic sophistication increases in both (a) own and (b) opponents' incentive levels. (c) Belief accuracy increases with higher own incentives.

Finally, we consider the extent to which incentive levels affect exerted cognitive effort, and how it, in turn, affects behaviour. Consistent with recent models of sequential reasoning in games (Alaoui and Penta, 2016; Gonçalves, 2024), we conjecture that higher incentives induce greater cognitive effort and this ultimately resultes in better choices. To operationalise testing of this mechanism, we follow existing literature and proxy cognitive effort through response times (see e.g. Alós-Ferrer and Buckenmaier, 2021; Frydman and Nunnari, 2023). Our last hypothesis is then:

Hypothesis 4 (Response Time)**.** (a) Response time increases with own incentive level. (b) Expected payoff increases with response time.

3. Experimental Design

3.1. Identification Strategy

Testing the effects of incentive levels on choices and beliefs in strategic settings poses a fundamental identification problem, since it requires holding fixed opponents' behaviour.

To see this, suppose we want to identify how higher incentives affect Anne's behaviour. On the one hand, Anne's higher incentives may have a direct effect on her behaviour. But if we also vary Anne's and Bob's incentives together, then Anne's changes in behaviour is a reaction both to her higher incentives as well as Bob's. Hence, one necessarily needs to vary only one player's incentive level at a time. On the other hand, even if we vary only Anne's incentives, Anne may behave differently, not because she faces higher incentives, but because she anticipates that Bob expects her to behave in a particular way when she has higher incentives — an indirect effect. In other words, simply observing how a player's behaviour changes would conflate a direct effect of the change in the incentive level and an indirect effect due to their perception of their opponents' reaction to it.

To address this issue we rely on the replacement method (Alaoui et al., 2020), which leverages insights of using 'observers' in belief elicitation experiments (e.g., Dawes et al., 1977; Huck and Weizsäcker, 2002; Palfrey and Wang, 2009; Hyndman et al., 2012). In short, Anne's payoffs depend on Bob's choice, who is playing in a game in which stakes are either high or low for both players. By varying Anne's incentives, we are able to isolate the direct effect from the indirect effect, holding fixed Bob's behaviour.

We implement the replacement method by randomly assigning participants to one of four incentive groups, which determine a participant's own incentive level and their opponents', each of which is high or low. Every participant plays against a randomly drawn participant drawn from an incentive group where all players have the same incentive level. This ensures that, if Anne is playing against someone with high incentives, Anne knows their opponent has high incentives, as does their opponent's opponent and so on, fixing Anne's opponent's behaviour regardless of Anne's incentives. This ensures that we are not only able (i) to hold fixed opponents' behaviour and compare how own incentive levels affect choices and beliefs, but also (ii) to hold fixed one's own incentive level and compare how opponents' incentive level affects their beliefs and choices.

3.2. Games

Participants faced one of the two normal-form games exhibited in Figure 1. Both games are dominance-solvable and share similar payoff structures. The dominance solutions in the games in panels (a) and (b) are, respectively, 2- and 3-rationalisable, that is, it takes two and three iterations of (maximal and simultaneous) deletion of strictly dominated strategies to reach the dominance solution strategy in each of the games. We opted for four-action games as this is the smallest number of actions that

Actions		Player 2 a_1	a_2	a_3	a_4
Player 1	a_1	40, 40	70, 30	80, 20	10, 10
	a_2	30, 70	40, 40	70, 30	80, 20
	a_3	20, 80	30, 70	40, 40	70, 30
	a_4	10, 10	20, 80	30, 70	40, 40

(a) 2 Steps

Actions		Player 2 a_1	a_2	a_3	a_4
Player 1	a_1	40, 40	70, 30	10, 20	10, 10
	a_2	30, 70	40, 40	70, 30	10, 20
	a_3	20, 10	30, 70	40, 40	70, 30
	a_4	10, 10	20, 10	30, 70	40, 40

(b) 3 Steps

Figure 1: Games

Notes: This figure exhibits the games used in the experiment. Both are symmetric, two-player dominance-solvable games, with the game in panel (a) taking 2 steps of iterated (maximal and simultaneous) deletion of strictly dominated strategies to obtain the strategy prescribed by the dominance solution, whereas the game in panel (b) takes 3 steps.

allows us to contrast how the number of iterations of deletion interacts with the incentive level, with only minor modifications in payoffs. Symmetry was imposed in order to improve statistical power and minimise data collection. Both exhibit similar payoffs and similar in spirit to 11-20 (Arad and Rubinstein, 2012) and undercutting games more generally (Nagel, 1995; Costa-Gomes and Crawford, 2006).

All actions in both games can be ranked in terms of sophistication. Specifically, actions deleted within the same round of iterated deletion are also ordered in terms of the dominance relation. For instance, in '2 Steps' (Figure 1(a)), (i) a_4 is strictly dominated by a_3, which in turn is strictly dominated by a_2, and (ii) upon deletion of a_3 and a_4, a_2 is iteratedly strictly dominated by a_1. Similarly, in '3 Steps' (Figure 1(b)), (i) a_4 is strictly dominated by a_3; (ii) deleting a_4 renders a_3 iteratedly strictly dominated by a_2, and (iii) deleting a_3, again a_2 is iteratedly strictly dominated by a_1. This implies that actions are ranked in terms of strategic sophistication in a simple manner: for any n, a_n is more sophisticated than a_{n+1}.

The games were also chosen so as to mitigate concerns about payoffs acting as focal coordination points and other-regarding preferences. First, we note that all payoff vectors are associated to multiple action profiles, and the dominance payoff (40,40) is too. Although the iterative structure of the game is apparent Figure 1, we randomly shuffled rows and columns. Second, the dominance payoff is neither Pareto dominated nor Pareto dominant, as are the majority of payoff vectors. This, together with the above-described random opponent matching protocol, was designed to alleviate concerns about focal coordination and other-regarding preferences.

In addition, the games satisfy a number of other desirable properties. Level-k actions are uniquely determined assuming level 0 uniformly randomises, regardless of participants' risk attitudes. In the 2 Steps game, a_2 is the level-1 action, and a_1 is the level-2 action; a_3 and a_4 are strictly dominated; in the 3 Steps game, a_3 is the level-1 action, a_2 is level-2, and a_1 is level-3. Logit quantal response equilibrium is uniquely defined in each game for any fixed level of sensitivity to payoff differences, and its action sophistication increases with higher payoff sensitivity. We refer to the '3 Steps' game as more complex and the '2 Steps' game as simpler, not only due to the order of rationalisability of the dominance solution, but also because several models of bounded rationality, mistakes, and costly cognition predict action distributions of lower sophistication in the former compared to the latter.[7]

3.3. Implementation Details

The experiment implemented a $2\times2\times2$ design, corresponding to own and opponent's incentive level and to the specific games played — 2 or 3 Steps as in Figure 1. The order of rows and columns was randomised and participants were informed of this. Participants were sorted into one of the 8 treatments uniformly at random, and played only once.

The experiment was incentivised via a binary lottery so that payoffs corresponded to the probability of getting paid a prize of $\$x$ versus \$2.00. In the high own incentive level treatment, $\$x$ corresponded to \$22.00 and in the low incentive level to \$2.50. The low incentive level was chosen to deliver a similar expected payment per game as in other experiments;[8] the high incentive level was chosen to be significantly high while avoiding the excessive unfamiliarity and stress caused by extreme financial stakes — we defer a discussion of the responses to such conditions to Section 7.

We elicited both an action in the game participants played, $a_i \in A_i := \{a_1, a_2, a_3, a_4\}$, and beliefs about their opponents' actions, $b_i = (b_{i,1}, b_{i,2}, b_{i,3}, b_{i,4}) \in \Delta(A_{-i})$. The payoffs obtained in the game directly correspond to a probability of getting the prize; belief elicitation was incentivised via a binarised scoring rule (Hossain and Okui, 2013). Choices and beliefs were elicited simultaneously, and, to preclude hedging, only one of them was randomly selected for payment. Incentives were designed to minimise other-regarding preferences; as we discuss in Appendix B, other-regarding preferences do not predict well choices.

The experiment proceeded as follows: (i) instructions were provided together with comprehension questions and attention checks; (ii) participants played two unincentivised practice rounds without feedback; (iii) own and opponent's incentive levels were revealed;[9] (iv) actions and beliefs were elicited; (v) participants answered a brief questionnaire on sociodemographics and received payment information. Screenshots of the interface and instructions are provided in Online Appendix B.

We targeted a minimum of 100 participants per treatment and recruited 834 participants in total, with the smallest treatment group having exactly 100 participants. Sessions were conducted on 9-10

[7] E.g., level-k, cognitive hierarchy, logit quantal response equilibrium, endogenous depth of reasoning, sequential sampling equilibrium.

[8] For instance, the average payments per game in Alaoui et al. (2020) and Fudenberg and Liang (2019) were €0.88 and \$0.93, respectively.

[9] Only 4 out of over 800 participants droped out of the experiment after knowing their incentive treatment: 3 with low incentives and 1 with high.

Game	Incentives		Action Frequency				Mean Belief Reports				Observations
IDS	Own	Opponent	a_1	a_2	a_3	a_4	b_1	b_2	b_3	b_4	N
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
2	High	High	0.573	0.272	0.087	0.068	0.330	0.357	0.189	0.124	103
2	High	Low	0.519	0.340	0.085	0.057	0.279	0.369	0.201	0.150	106
2	Low	High	0.359	0.359	0.146	0.136	0.268	0.317	0.230	0.185	103
2	Low	Low	0.343	0.363	0.157	0.137	0.265	0.315	0.238	0.181	102
3	High	High	0.144	0.490	0.298	0.067	0.184	0.311	0.363	0.142	104
3	High	Low	0.130	0.440	0.360	0.070	0.213	0.259	0.340	0.189	100
3	Low	High	0.196	0.330	0.312	0.161	0.219	0.275	0.320	0.186	112
3	Low	Low	0.192	0.288	0.365	0.154	0.222	0.270	0.327	0.180	104

Table 1: Action Frequency and Mean Beliefs

Notes: This table shows the action frequency and the mean beliefs by each of the treatments. Each participant is allocated to a given treatment — a game (2 Steps or 3 Steps), and an incentive level group specifying the participant's incentive level (high or low) and their opponent's incentive level (high or low). Participants play only one game and only once.

and 15-17 January 2020 on Amazon Mechanical Turk (MTurk), restricting participants to be adults based in the United States. Our choice of the participant pool was driven not only by the profession's standard at the time, but also by the fact that the participant pool is particularly sensitive to financial motivation. Participants' behaviour does not show any signs of inattention or significantly different behaviour from other lab participants; this is further discussed in Appendix C.

Participants faced no time constraint; the average duration was about 22 minutes and average earnings of $9.15 or $24.97 per hour. Sociodemographic data collected consisted of age, sex, education, and prior exposure to game theory (see Online Appendix A for details); samples across treatments were balanced across all sociodemographic variables.

4. Incentives and Choices

4.1. Action Sophistication

We begin by investigating how incentive levels affect the observed sophistication of actions, as hypothesized in Hypothesis 1. Our analysis reveals that participants do not consistently choose the dominance solution action (a_1). Table 1 presents the action frequencies and average beliefs across the eight treatments, highlighting substantial variation in the frequency of dominance play, which ranges from 13.0% to 57.3%. Similarly, the frequency of dominated actions (actions a_3 and a_4 in the 2 Steps game, and action a_4 in the 3 Steps game) varies considerably across treatments, from 6.7% to 16.1%.

To formally test the effects of incentive levels on dominance and dominated play, we estimate the

	Dominance Play		Dominated Play	
	(1)	(2)	(3)	(4)
	2 Steps	3 Steps	2 Steps	3 Steps
High Own Incent.	0.204***	-0.066	-0.141***	-0.095**
	(0.048)	(0.038)	(0.041)	(0.032)
High Opp. Incent.	0.013	0.008	0.015	0.004
	(0.049)	(0.037)	(0.040)	(0.032)
Controls	Yes	Yes	Yes	Yes
R^2	0.14	0.05	0.10	0.09
N	414	420	414	420

Heteroskedasticity-robust standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 2: Incentive Level, Dominance and Dominated Play (Hypothesis 1)

Notes: This table shows the results for the regression specified in equation 1, considering as dependent variable an indicator for whether the participant chose the dominance solution (columns (1) and (2)) or a strictly dominated action (columns (3) and (4)). High Own/Opponent Incentives correspond to indicators for whether the participant and their opponent face a high incentive level. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Controls refer to the participants' age, sex, education, and prior exposure to game theory.

following specification:

$$y_i = \beta_0 + \beta_1 H_i + \beta_2 H_{-i} + \text{Controls}_i + \epsilon_i \tag{1}$$

where H_i is an indicator variable equal to 1 if participant i's treatment had a high own incentive level, and H_{-i} is an analogous indicator for whether participant i's opponent had a high incentive level. Controls include participants' age, sex, education, and prior exposure to game theory. The dependent variable, y_i, is an indicator for whether participant i chose the dominance solution action (for testing dominance play) or a strictly dominated action (for testing dominated play). Table 2 presents the results.

We find that higher own incentives significantly decrease the frequency of dominated play and increase the frequency of the dominance solution action, but only in the 2 Steps game. Specifically, dominated play decreases in both games — by 14.1 percentage points (pp) in the 2 Steps game and 9.5 pp in the 3 Steps game (columns (3) and (4)). Dominance play is only significantly affected in the 2 Steps game, where it increases by over 20 pp (columns (1) and (2)). These results suggest that more complex games may require higher incentive levels to elicit the same degree of dominance play. Furthermore, we find no evidence that opponents' incentives affect dominance or dominated play.

Next, we examine the overall distribution of actions, shown in Figure 2. For each game and opponent's incentive level, the distribution of actions differs significantly across own incentive levels (Wald tests, $p < .05$). In the 2 Steps game, higher own incentives shift the action distribution to-

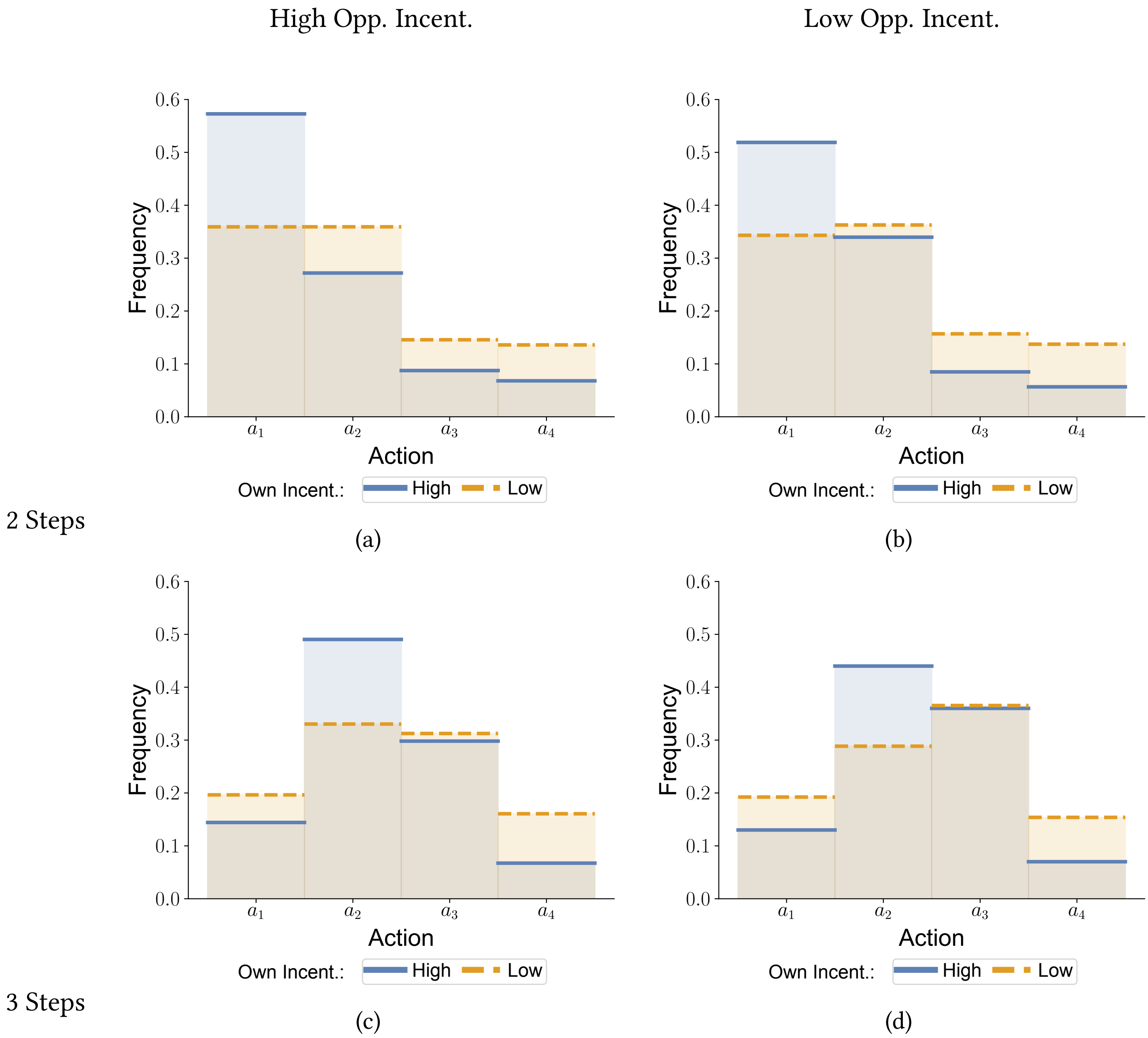


Figure 2: Incentive Level and Action Frequency (Hypothesis 1)

Notes: The panels exhibit the action frequency for high and low own incentive levels, for different games (2 Steps, (a) and (b), and 3 Steps, (c) and (d)) and holding fixed the opponent's incentive level (High, (a) and (c), or Low, (b) and (d)). 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1).

wards more sophisticated actions in a first-order stochastic dominance manner (Mann-Whitney U test, $p < .01$). This is not the case for the 3 Steps game, where the decrease in the frequency of action a_1 (panels (c) and (d)) indicates that the distributions are not ranked by first-order stochastic dominance (Mann-Whitney U test, $p > .25$). However, the distributions are still statistically different (Fisher's exact tests, $p < .05$), with higher incentives leading to a less flat distribution and a higher probability assigned to a_2, the level-2 action. Indeed, we find that the action distribution shifts in a *second-order* stochastic dominance manner, implying that choices become less noisy and stochastically more sophisticated with higher incentives.

These findings provide partial support for Hypothesis 1a. The fact that higher own incentives lead to more sophisticated play suggests that strategic sophistication, as captured by level-k and cognitive hierarchy models, may depend on the incentive *level* players face. However, we find no support for Hypothesis 1b, as there is no statistically significant effect of opponents' incentive levels on action sophistication.

4.2. Mistakes

Higher incentives may lead to fewer mistakes, as they increase the cost of errors. This is the core idea behind Hypothesis 2. We investigate this by examining two types of best-response rates: (i) subjective best responses, where participants best respond to their stated beliefs, and (ii) objective best responses, where participants best respond to the observed frequency of play.

	Subjective BR		Objective BR	
	(1)	(2)	(3)	(4)
	2 Steps	3 Steps	2 Steps	3 Steps
High Own Incent.	0.219***	0.151**	0.204***	0.042
	(0.049)	(0.051)	(0.048)	(0.044)
High Opp. Incent.	-0.021	0.027	0.013	-0.195***
	(0.050)	(0.050)	(0.049)	(0.044)
Controls	Yes	Yes	Yes	Yes
R^2	0.11	0.06	0.14	0.10
N	414	420	414	420

Heteroskedasticity-robust standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 3: Incentive Level and Best-Response Rate (Hypothesis 2a)

Notes: This table shows the results for the regression specified in equation 1, considering as dependent variable an indicator for whether the participants best respond to their beliefs — i.e. chose the action that maximises expected payoffs according to their reported beliefs (columns (1) and (2)) — and for if participants best respond to the empirical frequency of actions of their opponents — i.e. objective best responses (columns (3) and (4)). High Own/Opponent Incentives correspond to indicators for whether the participant and their opponent face a high incentive level. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Controls refer to the participants' age, sex, education, and prior exposure to game theory.

Table 3 presents the results from estimating a specification analogous to equation 1. We find that higher own incentives significantly increase the subjective best-response rate by 21.9 percentage points (pp) in the 2 Steps game and 15.1 pp in the 3 Steps game (columns (1) and (2)).[10] This effect is not consistently observed for objective best responses (columns (3) and (4)). These results suggest that higher incentives encourage participants to better align their actions with their beliefs, but not

[10]Best-response rates to stated beliefs in the data are between 40-50% in the low own incentive level treatment and 60-70% in the high own incentive level treatment — this corresponds to the frequency of the choosing the action with subjective rank 1 as exhibited in Figure 3. These figures are comparable to what has been observed in two-player three-action games, e.g., Costa-Gomes and Weizsäcker (2008) and Rey-Biel (2009).

necessarily with the actual distribution of opponents' actions.

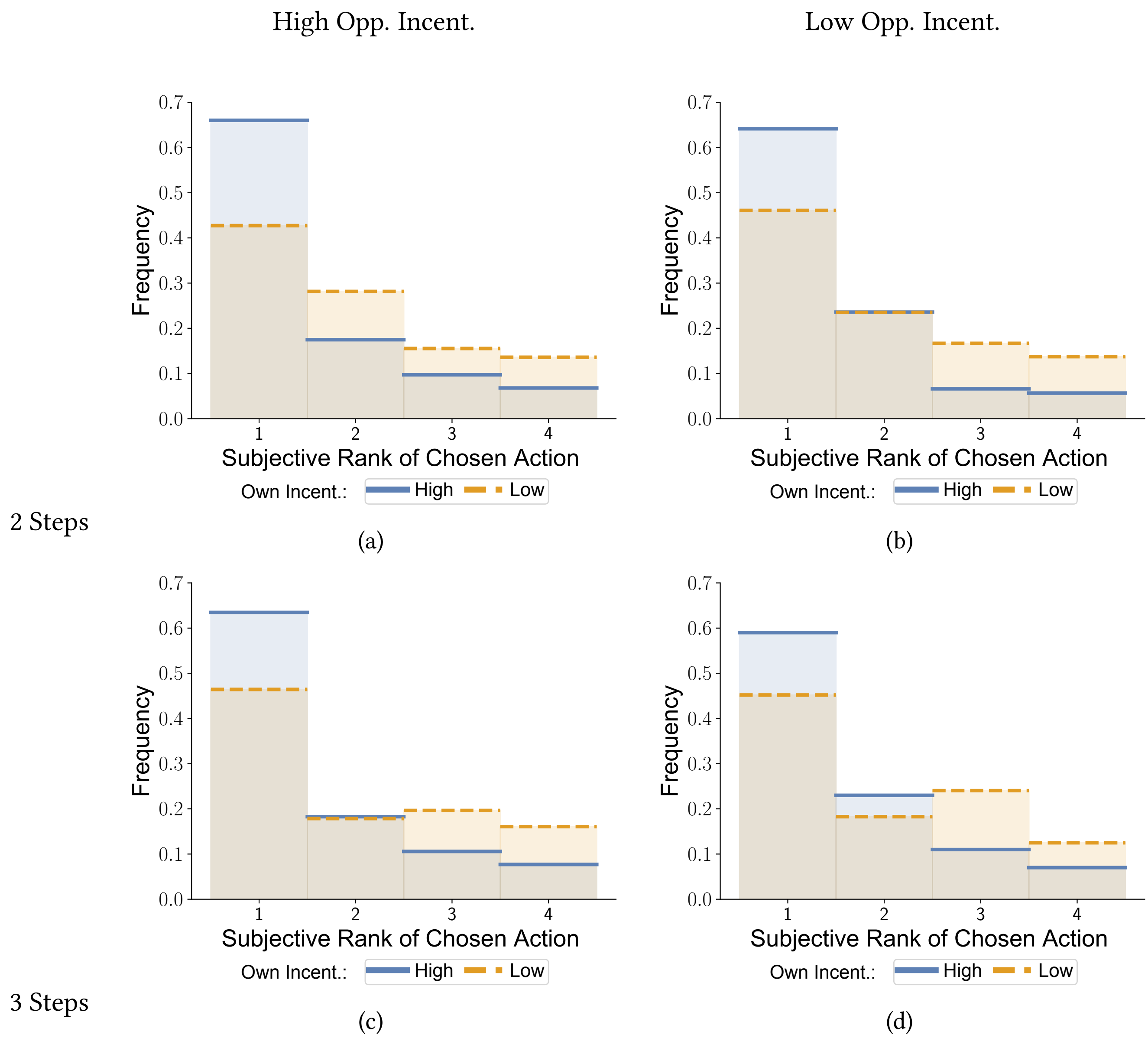


Figure 3: Incentive Level and Subjective Mistakes (Hypothesis 2b)

Notes: The different panels exhibit the frequency of the subjective rank of the action chosen by the participant for high and low own incentive levels, for different games (2 Steps, (a) and (b), and 3 Steps, (c) and (d)) and holding fixed the opponent's incentive level (High, (a) and (c), or Low, (b) and (d)). The subjective rank of an action is n if the action entails the n-th highest subjective expected payoffs according to the reported beliefs; e.g., actions with subjective rank 1 are those that maximise subjective expected payoffs. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1).

A key prediction of quantal response equilibrium (QRE) theory is that actions with higher expected payoffs are chosen more often, a property known as 'monotonicity' (cf. Goeree et al., 2005). To examine this, we define the subjective rank of an action as its rank in terms of subjective expected payoffs, based on reported beliefs. Figure 3 displays the frequency of actions by their subjective rank. We find strong support for monotonicity with respect to subjective expected payoffs: actions with higher subjective ranks are indeed chosen more frequently (Mann-Whitney U rank tests, $p < .05$). However, this pattern does not hold when considering objective expected payoffs (see Figure 7 in Appendix A).

Furthermore, higher own incentives not only reduce the frequency of mistakes (as measured by subjective best-response rates), but also decrease their severity. The distribution of subjective ranks shifts in a first-order stochastic dominance sense with higher own incentives, indicating that participants are less likely to make large mistakes (i.e., choose actions with very low subjective expected payoffs).

To assess the extent to which QRE can explain our data, we fit a logit QRE model to the data. The estimated action frequencies are presented in Appendix A. We find that while the standard logit QRE model performs well in the 2 Steps game, it overpredicts action sophistication in the 3 Steps game. However, incorporating participants' reported beliefs, as in a subjective logit QRE model, significantly improves the fit, increasing the loglikelihood by 28%. This highlights the importance of considering subjective beliefs when modelling strategic behaviour under incentives.

Overall, these findings provide strong evidence for Hypothesis 2, demonstrating that higher incentives lead to both a higher rate and lower severity of mistakes, as measured by subjective best responses. Moreover, the results suggest that incorporating subjective beliefs can improve the predictive accuracy of QRE models.

5. Incentives and Beliefs

Having established the impact of incentives on action sophistication, we now examine their effect on beliefs, as postulated in Hypothesis 3. This hypothesis suggests that beliefs about opponents' behaviour are influenced by both own and opponents' incentive levels, and that higher own incentives lead to more accurate beliefs.

Figure 4 presents the average belief reports for each treatment. A visual inspection reveals that in the 2 Steps game, higher own incentives lead to a clear shift in beliefs towards greater opponent sophistication, evident in the first-order stochastic dominance ordering of the belief distributions (panels (a) and (b)). This shift is less pronounced in the 3 Steps game. While beliefs become less uniform when opponents have high incentives, they are indistinguishable when opponents have low incentives (panels (c) and (d)).

To formally assess the effects of incentives on beliefs, we again use the specification in equation 1. In this case, the dependent variable is either the belief that the opponent will play the dominance solution action ($b_{i,1}$) or the belief that the opponent will play a dominated action ($b_{i,3} + b_{i,4}$ for the 2 Steps game, and $b_{i,4}$ for the 3 Steps game). Table 4 presents the results.

Consistent with Figure 4, we find that higher own incentives lead to a statistically significant increase

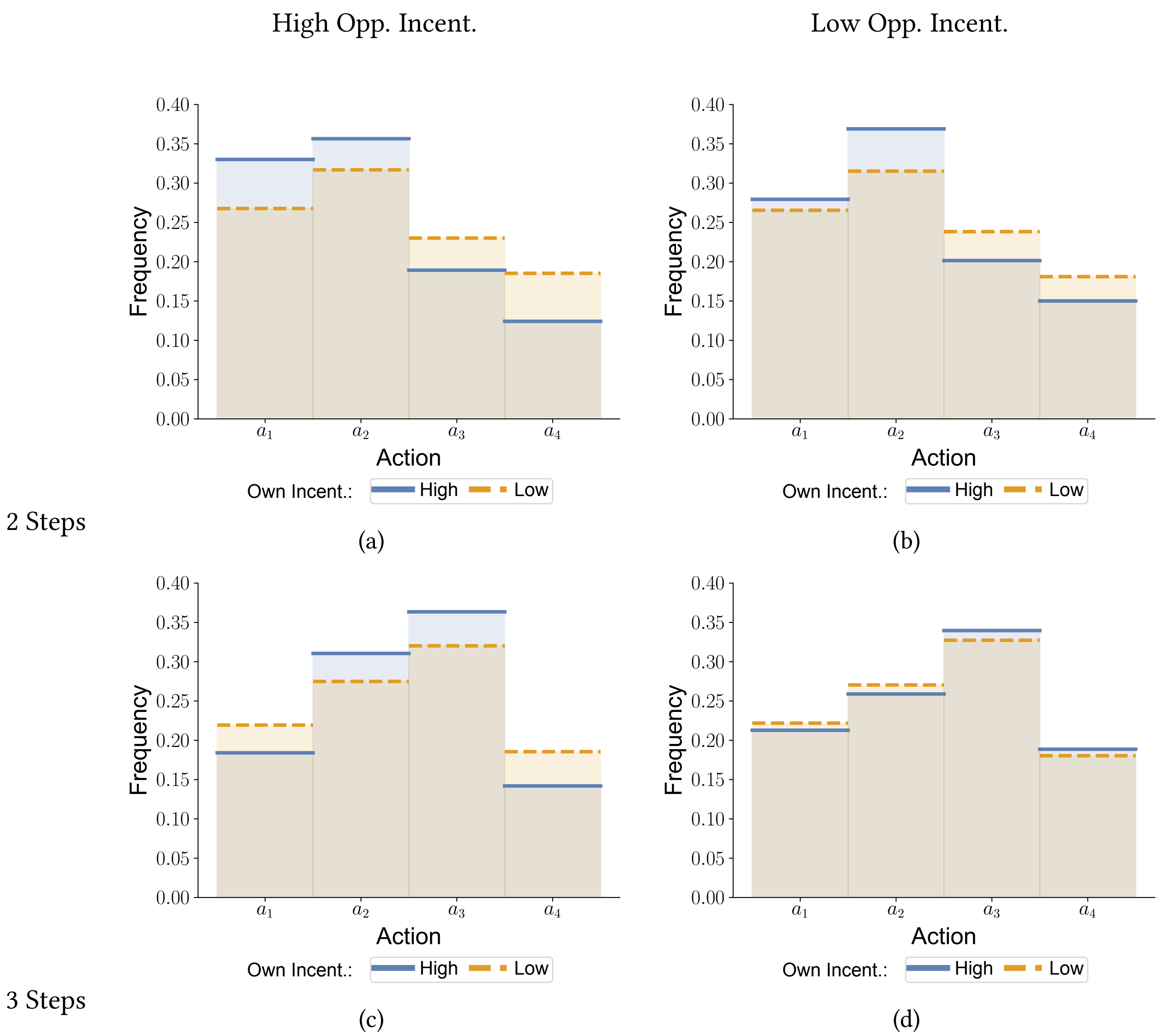


Figure 4: Incentive Level and Mean Beliefs

Notes: The different panels exhibit the mean reported beliefs for high and low own incentive levels, for different games (2 Steps, (a) and (b), and 3 Steps, (c) and (d)) and holding fixed the opponent's incentive level (High, (a) and (c), or Low, (b) and (d)). 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1).

in the belief that the opponent will choose the dominance solution action, thus lending support to Hypothesis 3a. While the coefficient for opponents' incentives also has a positive sign, it is not statistically significant. However, a closer look suggests that only when own incentives are high are participants' beliefs reactive to opponents' incentives: they recognising that opponents are less noisy and tend to be more sophisticated when facing higher incentives (a second-order stochastic dominance shift in beliefs), thus providing some support for Hypothesis 3b.

Finally, we address the question of whether higher incentives lead to more accurate beliefs (Hypothesis 3c). Table 5 presents the results from regressions examining three measures of belief accuracy:

	Belief Dominance Play		Belief Dominated Play	
	(1)	(2)	(3)	(4)
	2 Steps	3 Steps	2 Steps	3 Steps
High Own Incent.	0.035*	-0.021	-0.074***	-0.019
	(0.016)	(0.014)	(0.018)	(0.013)
High Opp. Incent.	0.020	-0.020	-0.020	-0.016
	(0.017)	(0.014)	(0.018)	(0.013)
Controls	Yes	Yes	Yes	Yes
R^2	0.10	0.06	0.15	0.06
N	414	420	414	420

Heteroskedasticity-robust standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 4: Incentive Level and Belief in Opponent Sophistication (Hypothesis 3a,b)

Notes: This table shows the results for the regression specified in equation 1, considering as dependent variable the reported belief in dominance play, $b_{i,1}$, (columns (1) and (2)) or the reported belief in strictly dominated play, $b_{i,3} + b_{i,4}$ in column (3) and $b_{i,4}$ in column (4). High Own/Opponent Incentives correspond to indicators for whether the participant and their opponent face a high incentive level. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Controls refer to the participants' age, sex, education, and prior exposure to game theory.

	|Belief - Opponent Action Frequency|				|Subjective EU - Objective EU|	
	Dominance Play		Dominated Play			
	(1)	(2)	(3)	(4)	(5)	(6)
	2 Steps	3 Steps	2 Steps	3 Steps	2 Steps	3 Steps
High Own Incent.	0.005	0.011	-0.040***	-0.015	-4.345***	0.558
	(0.011)	(0.010)	(0.011)	(0.010)	(1.282)	(1.403)
High Opp. Incent.	0.037***	0.062***	0.033**	0.021*	4.222***	9.520***
	(0.011)	(0.009)	(0.012)	(0.010)	(1.277)	(1.416)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.14	0.14	0.14	0.06	0.17	0.15
N	414	420	414	420	414	420

Heteroskedasticity-robust standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 5: Incentive Level and Belief Accuracy (Hypothesis 3c)

Notes: This table shows the results for the regression specified in equation 1, considering as dependent variable the absolute difference between reported belief in dominance play by opponents and its realised frequency, $|b_{i,1} - \overline{\sigma}_{-i,1}|$, (columns (1) and (2)), or the analogous absolute difference for strictly dominated play, $|(b_{i,3} + b_{i,4}) - (\overline{\sigma}_{-i,3} + \overline{\sigma}_{-i,4})|$ in column (3) and $|b_{i,4} - \overline{\sigma}_{-i,4}|$ in column (4). In columns (5) and (6) the dependent variable is the (L1) distance between subjective expected payoffs (according to reported beliefs) and objective expected payoffs (according to observed action frequencies). High Own/Opponent Incentives correspond to indicators for whether the participant and their opponent face a high incentive level. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Controls refer to the participants' age, sex, education, and prior exposure to game theory.

(i) distance between the reported belief in the dominance action being chosen and its empirical frequency, (ii) the analogous difference for dominated actions, and (iii) the (L1) distance between subjective expected payoffs (based on reported beliefs) and objective expected payoffs (based on actual action frequencies).

We find that higher own incentives tend to improve belief accuracy, but only significantly so in the simpler game. This is both in terms of beliefs about dominated actions and in terms of overall subjective expected payoffs. Furthermore, opponents with higher incentives seem to be harder to predict, possibly because they deviate further from simple heuristics or level-0 play. In contrast, the effect of own incentives on belief accuracy is mixed.

In summary, our findings on beliefs offer nuanced support for Hypothesis 3. While higher own incentives generally lead to beliefs that attribute greater sophistication to opponents, the magnitude of this effect may depend on the incentives faced by opponents. Moreover, the impact of incentives on belief accuracy appears to be context-dependent, with significant improvements observed only in the simpler 2 Steps game.

6. Incentives and Response Times

	Log(Response Time)	
	(1)	(2)
	2 Steps	3 Steps
High Own Incent.	0.478***	0.362***
	(0.074)	(0.082)
High Opp. Incent.	0.077	0.132
	(0.076)	(0.078)
Controls	Yes	Yes
R^2	0.17	0.18
N	414	420

Heteroskedasticity-robust standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 6: Incentive Level and Response Time (Hypothesis 4a)

Notes: This table shows the results for the regression specified in equation 1, considering as dependent variable the participants' log response time (in seconds). High Own/Opponent Incentives correspond to indicators for whether the participant and their opponent face a high incentive level. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Controls refer to the participants' age, sex, education, and prior exposure to game theory.

Finally, we examine the effect of incentive levels on cognitive effort, as proxied by participants' response times. Hypothesis 4 posits that higher incentives increase response times and that longer response times are associated with better performance.

Table 6 presents the results from regressing log response time (in seconds) on incentive level treatments, using the same specification as in equation 1. Consistent with Hypothesis 4a, we find that higher own incentives lead to a substantial increase in response times, exceeding 40%. This contrasts with the findings of Alós-Ferrer and Buckenmaier (2021), where higher incentives in the 11-20 game were associated with shorter response times. This discrepancy may stem from differences in the strategic complexity of the games employed.

	Objective BR		Log(Expected Payoff)	
	(1)	(2)	(3)	(4)
	2 Steps	3 Steps		
Log(Response Time)	0.131***	0.075**	0.084***	0.065***
	(0.033)	(0.028)	(0.020)	(0.013)
High Own Incent.	0.142**	0.015	0.080*	0.040
	(0.052)	(0.044)	(0.032)	(0.022)
High Opp. Incent.	0.003	-0.205***	-0.079**	-0.045*
	(0.048)	(0.043)	(0.028)	(0.021)
Controls	Yes	Yes	Yes	Yes
R^2	0.17	0.12	0.16	0.12
N	414	420	414	420

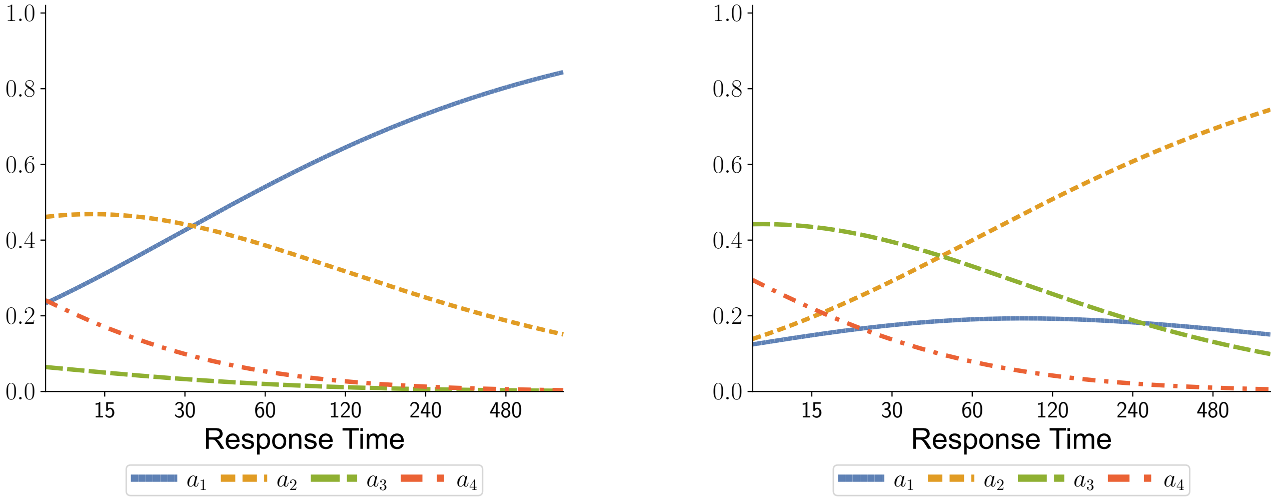
Heteroskedasticity-robust standard errors in parentheses.
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 7: Response Time, Best Responses, and Payoffs (Hypothesis 4b)

Notes: This table examines the relation between, on the one hand, log response times (in seconds), and on the other objective best responses to the empirical frequency of opponents' actions (columns (1) and (2)) and log expected payoffs, where expectations are taken also with respect to the empirical frequency of opponents' actions (columns (3) and (4)). High Own/Opponent Incentives correspond to indicators for whether the participant and their opponent face a high incentive level. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Controls refer to the participants' age, sex, education, and prior exposure to game theory.

To investigate whether this increased cognitive effort translates into improved performance, we examine the relationship between response times and (i) the rate of objective best responses (i.e., best responses to the empirical frequency of opponents' actions) and (ii) objective expected payoffs (based on the empirical frequency of opponents' actions). Table 7 shows that longer response times are indeed associated with both a higher rate of objective best responses and an increase in expected payoffs, although the elasticity of payoffs with respect to response time is small. These associations hold even after controlling for incentive level treatments and individual characteristics such as age, education level, field of education, and prior exposure to game theory. While these findings support Hypothesis 4b, it is important to note that these are measures of association and not causally identified effects.

To further explore the relationship between response times and strategic behaviour, we conduct a descriptive analysis of how actions and beliefs vary with response time. For actions, we estimate a multinomial logistic model, regressing actions on response time, incentive treatments, and individ-

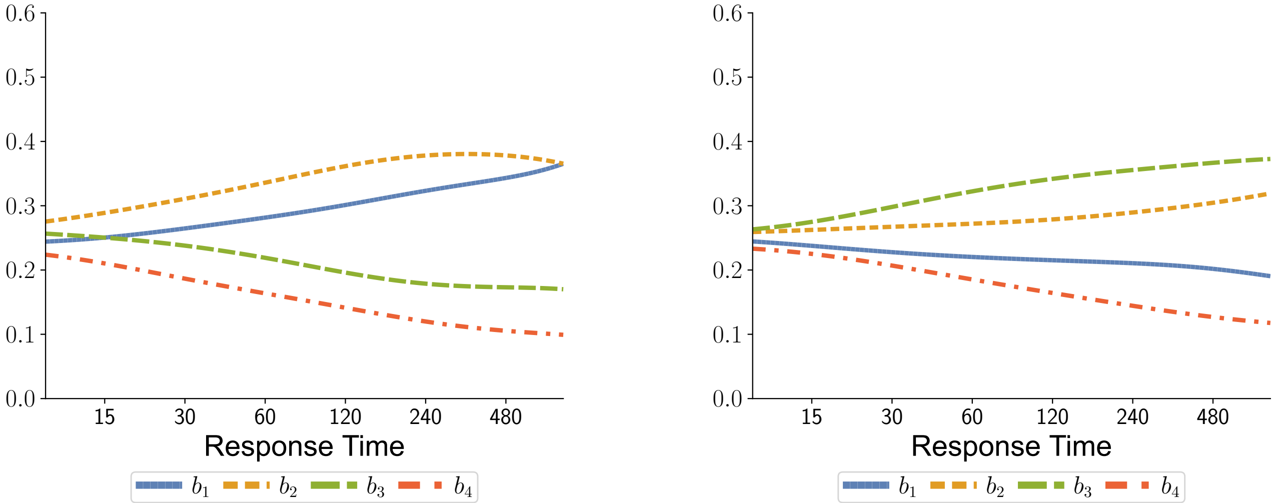


(a) 2 Steps

(b) 3 Steps

Figure 5: Action Frequency and Response Time

Notes: This figure shows the predicted relation between action frequency and response time (in seconds). The predictions are given by multinomial logit estimation of the relation between participants' choices, on the one hand, and response time, incentive treatments, and individual characteristics, estimated separately for each game. The action frequency conditional on response times is given by marginalising over the other regressors. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Individual characteristics refer to the participants' age, sex, education, and prior exposure to game theory.



(a) 2 Steps

(b) 3 Steps

Figure 6: Beliefs and Response Time

Notes: This figure shows the predicted relation between mean beliefs and response time (in seconds). The predictions are given by kernel estimation of the relation between participants' choices, on the one hand, and response time, incentive treatments, and individual characteristics, estimated separately for each game. The expected beliefs conditional on response times is obtained by using the estimated joint conditional probability distribution over a grid on the simplex $\Delta(A_i)$ and marginalising over covariates other than response times. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Individual characteristics refer to the participants' age, sex, education, and prior exposure to game theory.

ual characteristics. We then obtain the predicted action frequencies conditional on response times by marginalising over the other regressors. For beliefs, we use nonparametric kernel estimation to estimate the *conditional* distribution of mean beliefs, $b_i = (b_{i,1}, b_{i,2}, b_{i,3}, b_{i,4})$, given response time, incentive treatments, and individual characteristics. From this, we obtain the expected beliefs conditional on response times. The results are shown in Figures 5 and Figures 6.

Our analysis reveals two key patterns. First, in the simpler 2 Steps game, longer response times are associated with both greater action and belief sophistication. As shown in Figure 5a, the predicted frequency of dominated actions (a_3 and a_4) declines rapidly with response time, while the frequency of the level-1 action (a_2) initially increases and then decreases. The frequency of the dominance solution action (a_1) increases monotonically with response time. Similarly, Figure 6a shows that longer response times are associated with a lower belief in opponents choosing dominated actions and a higher belief in opponents choosing the level-1 and level-2 actions.

Second, in the 3 Steps game, we observe analogous patterns for actions and beliefs at the same level of sophistication. Figure 5b shows that the frequency of dominated actions decreases with response time, while the frequencies of the level-1 and level-2 actions follow similar patterns as in the 2 Steps game. However, the frequency of the dominance solution action remains low and relatively invariant with respect to response time. Beliefs follow the same patterns (Figure 6b), with longer response times associated with a lower belief in dominated actions and a higher belief in level-1 and level-2 actions. Notably, the belief in the dominance solution action (level-3) slightly decreases with response time in this game.

In essence, fast decisions are associated with intuitive choices (level-1 actions) and beliefs closer to uniform, while slower decisions are associated with more sophisticated actions (level-2) and beliefs, with a decrease in both dominated choices and beliefs in dominated actions.

These findings, coupled with the positive relationship between incentives and response times, suggest a consistent mechanism: higher incentives induce greater cognitive effort, leading to more sophisticated actions and beliefs. This supports the intuition behind models of sequential reasoning (e.g., Alaoui and Penta, 2016; Gonçalves, 2024), where individuals engage in a cost-benefit analysis to determine how much to reason.

7. Concluding Remarks

This paper provides well-identified evidence that incentive levels affect behaviour in strategic settings. Our findings highlight the multifaceted role of incentives in shaping strategic decision-making, influencing not only choices but also beliefs and the cognitive effort invested in reaching those decisions.

We find that own incentives are crucial in determining both the propensity to make mistakes and the level of cognitive effort exerted. Higher own incentives lead to fewer mistakes and increased cognitive effort, as evidenced by longer response times. This greater cognitive effort, in turn, translates into more accurate beliefs about opponents' behaviour. However, the effects of incentives are not uniform across games. While higher incentives lead to more sophisticated choices and more accurate beliefs in the simpler game, the differences are less pronounced in the more complex game. This suggests that the efficacy of incentives in promoting strategic sophistication may be contingent on the cognitive demands of the environment.

While own incentives play a dominant role, we also find evidence that behaviour is influenced by opponents' incentive levels. Specifically, when opponents face higher incentives, they are expected to play in a more sophisticated manner. Additionally, reported beliefs track changes in opponents' choices when their incentive level increases but also become more biased; this indicates that high incentives reduce the predictability conferred by noisier (more uniform) behaviour.

It is important to note that the relationship between incentives and performance is not always straightforward. The Yerkes-Dodson law (Yerkes and Dodson, 1908) posits an inverted U-shaped relationship between incentives and performance. In our context, this suggests that there may be limits to the benefits of increasing incentives. While moderate increases in incentives can promote more sophisticated and accurate decision-making, excessive incentives could potentially lead to decreased performance due to heightened pressure or anxiety. This is consistent with findings in other domains, where very high incentives can sometimes lead to choking under pressure or other detrimental effects on performance (Ariely et al., 2009; Enke et al., 2023).

Overall, our findings suggest that both payoff-dependent mistakes and cognitive effort, as proxied by response times, are important channels through which incentives affect strategic behaviour. The fact that the effects of incentives are more pronounced in the simpler game underscores the importance of considering the interplay between incentives and environmental complexity. Future research could explore the limits of incentives in promoting strategic sophistication and how these limits vary across environments with different cognitive demands.

Our results also highlight the importance of response times as a valuable source of information about cognitive processes in strategic decision-making. Response times are often readily available and can provide valuable insights into the underlying mechanisms driving strategic behaviour. Further development of game-theoretic models and experimental designs that incorporate response times could significantly enhance our understanding of strategic decision-making.

8. References

Agranov, M., E. Potamites, A. Schotter, and C. Tergiman. 2012. "Beliefs and endogenous cognitive levels: An experimental study." *Games and Economic Behavior* 75 (2): 449–63. 10.1016/j.geb.

2012.02.002.

Alaoui, L., K. A. Janezic, and A. Penta. 2020. "Reasoning about Others' Reasoning." *Journal of Economic Theory* 189 1–51. 10.1016/j.jet.2020.105091.

Alaoui, L., and A. Penta. 2016. "Endogenous Depth of Reasoning." *Review of Economic Studies* 83 (4): 1297–1333. 10.1093/restud/rdv052.

Alaoui, L., and A. Penta. 2022a. "Cost-Benefit Analysis in Reasoning." *Journal of Political Economy* 130 (4): 881–925.

Alaoui, L., and A. Penta. 2022b. "Cost-Benefit Analysis in Reasoning." *Journal of Political Economy* 130 (4): 881–925. 10.1086/718378.

Alós-Ferrer, C., and J. Buckenmaier. 2021. "Cognitive Sophistication and Deliberation Times." *Experimental Economics* 24 558–592. 10.1007/s10683-020-09672-w.

Andersen, S., S. Ertaç, U. Gneezy, M. Hoffman, and J. A. List. 2011. "Stakes Matter in Ultimatum Games." *American Economic Review* 101 (7): 3427–3439. 10.1257/aer.101.7.3427.

Arad, A., and A. Rubinstein. 2012. "The 11-20 money request game: A level-k reasoning study." *American Economic Review* 102 (7): 3561–3573. 10.1257/aer.102.7.3561.

Ariely, D., U. Gneezy, G. Loewenstein, and N. Mazar. 2009. "Large Stakes and Big Mistakes." *Review of Economic Studies* 76 (2): 451–469. 10.1111/j.1467-937X.2009.00534.x.

Camerer, C. 2003. *Behavioral Game Theory: Experiments in Strategic Interaction.* Princeton University Press.

Camerer, C., T.-H. Ho, and J.-K. Chong. 2004. "A Cognitive Hierarchy Model of Games." *Quarterly Journal of Economics* 119 (3): 861–898. 10.1162/0033553041502225.

Caplin, A., D. Csaba, J. Leahy, and O. Nov. 2020. "Rational Inattention, Competitive Supply, and Psychometrics." *Quarterly Journal of Economics* 135 (3): 1681–724. 10.1093/qje/qjaa011.

Caplin, A., and M. Dean. 2015. "Revealed Preference, Rational Inattention, and Costly Information Acquisition." *American Economic Review* 105 (7): 2183–2203. 10.1257/aer.20140117.

Clithero, J. A. 2018. "Response times in economics: Looking through the lens of sequential sampling models." *Journal of Economic Psychology* 69 61–86. 10.1016/j.joep.2018.09.008.

Costa-Gomes, M. A., and V. P. Crawford. 2006. "Cognition and Behavior in Two-Person Guessing Games: An Experimental Study." *American Economic Review* 96 (5): 1737–1768. 10.1257/aer.96.5.1737.

Costa-Gomes, M. A., and G. Weizsäcker. 2008. "Stated Beliefs and Play in Normal Form Games." *Review of Economic Studies* 75 (3): 729–762. 10.1111/j.1467-937X.2008.00498.x.

Dawes, R. M., D. G. McTavish, and H. Shaklee. 1977. "Behavior, Communication, and Assumptions about Other People's Behavior in a Commons Dilemma Situation." *Journal of Personality and Social Psychology* 35 (1): 1–11. 10.1037/0022-3514.35.1.1.

Dean, M., and N. Neligh. 2022. "Experimental Tests of Rational Inattention." *Journal of Political Economy* Forthcoming.

D.Gill, and V. Prowse. 2022. "Strategic Complexity and the Value of Thinking." *Economic Journal* 133 761–86. 10.1093/ej/ueac070.

Dow, J., and S. R. C. Werlang. 1994. "Nash Equilibrium under Knightian Uncertainty: Breaking Down Backward Induction." *Journal of Economic Theory* 63 305–324.

Eichberger, J., and D. Kelsey. 2000. "Non-additive beliefs and strategic equilibria." *Games and Economic Behavior* 30 183–215.

Enke, B., U. Gneezy, B. Hall, D. C. Martin, V. Nelidov, T. Offerman, and J. van de Ven. 2023. "Cognitive Biases: Mistakes or Missing Stakes?" *The Review of Economics and Statistics* 105 (4): 818–832. 10.1162/rest_a_01093.

Forstmann, B., R. Ratcliff, and E.-J. Wagenmakers. 2016. "Sequential Sampling Models in Cognitive Neuroscience: Advantages, Applications, and Extensions." *Annual Review of Psychology* 67 (1): 641–666. 10.1146/annurev-psych-122414-033645.

Friedman, E. 2022. "Stochastic Equilibria: Noise in Actions or Beliefs?" *American Economic Journal: Microeconomics* 14 (1): 94–142.

Friedman, E., and J. Ward. 2022. "Stochastic Choice and Noisy Beliefs in Games: an Experiment." *Working Paper* 1–77.

Frydman, C., and S. Nunnari. 2023. "Coordination with Cognitive Noise." *Working Paper.* 10.2139/ssrn.3939522.

Fudenberg, D., R. Iijima, and T. Strzalecki. 2015. "Stochastic Choice and Revealed Perturbed Utility." *Econometrica* 83 (6): 2371–2409. 10.3982/ECTA12660.

Fudenberg, D., and A. Liang. 2019. "Predicting and Understanding Initial Play." *American Economic Review* 109 (12): 4112–4141. 10.1257/aer.20180654.

Fudenberg, D., P. Strack, and T. Strzalecki. 2018. "Speed, Accuracy, and the Optimal Timing of Choices." *American Economic Review* 108 (12): 3651–3684. 10.1257/aer.20150742.

Georganas, S., P. J. Healy, and R. A. Weber. 2015. "On the Persistence of Strategic Sophistication." *Journal of Economic Theory* 159 369–400. 10.1016/j.jet.2015.07.012.

Goeree, J., C. Holt, and T. Palfrey. 2005. "Regular Quantal Response Equilibrium." *Experimental Economics* 8 (4): 347–367. 10.1007/s10683-005-5374-7.

Goeree, J. K., and C. A. Holt. 2001. "Ten Little Treasures of Game Theory and Ten Intuitive Contradictions." *American Economic Review* 91 (5): 1402–1422. 10.1257/aer.91.5.1402.

Gonçalves, D. 2024. "Sequential Sampling Equilibrium." *Working Paper* 1–53. 10.48550/arXiv.2212.07725.

Gonçalves, D., J. Libgober, and J. Willis. 2024. "Retractions: Updating from Complex Information." *Working Paper* 1–107. 10.48550/arXiv.2106.11433.

Holt, C. A., J. K. Goeree, and T. Palfrey. 2016. *Quantal Response Equilibrium: A Stochastic Theory of Games.* Princeton University Press.

Hossain, T., and R. Okui. 2013. "The Binarized Scoring Rule." *Review of Economic Studies* 80 (3):

984–1001. 10.1093/restud/rdt006.

Huck, S., and G. Weizsäcker. 2002. "Do players correctly estimate what others do? Evidence of conservatism in beliefs." *Journal of Economic Behavior and Organization* 47 (1): 71–85. 10.1016/S0167-2681(01)00170-6.

Hyndman, K., E. Y. Ozbay, A. Schotter, and D. Ehrblatt. 2012. "Convergence: An experimental study of teaching and learning in repeated games." *Experimental Economics* 15 (3): 323–344. 10.1007/s10683-011-9308-1.

Klibanoff, P. 1996. "Uncertainty, Decision and Normal form Games." *Mimeo* 1–39.

Kneeland, T. 2015. "Identifying Higher-Order Rationality." *Econometrica* 83 (5): 2065–2079. 10.3982/ECTA11983.

Luce, D. 1959. *Individual choice behavior.* John Wiley.

Matějka, F., and A. McKay. 2015. "Rational Inattention to Discrete Choices: A New Foundation for the Multinomial Logit Model." *American Economic Review* 105 (1): 272–298. 10.1257/aer.20130047.

Mattsson, L.-G., and J. Weibull. 2002. "Probabilistic choice and procedurally bounded rationality." *Games and Economic Behavior* 41 (1): 61–78. 10.1016/S0899-8256(02)00014-3.

McFadden, D. 1974. "Conditional logit analysis of qualitative choice behavior." In *Frontiers in Econometrics*, edited by Karembka, P. 105–142, Academic Press.

McKelvey, R. D., and T. R. Palfrey. 1992. "An Experimental Study of the Centipede Game." *Econometrica* 60 (4): 803–36. 10.2307/2951567.

McKelvey, R. D., and T. R. Palfrey. 1995. "Quantal Response Equilibria for Normal Form Games." *Games and Economic Behavior* 10 (1): 6–38. 10.1006/game.1995.1023.

McKelvey, R. D., T. R. Palfrey, and R. Weber. 2000. "The effects of payoff magnitude and heterogeneity on behavior in 2×2 games with unique mixed strategy equilibria." *Journal of Economic Behavior & Organization* 42 (4): 523–548. 10.1016/s0167-2681(00)00102-5.

Nagel, R. 1995. "Unraveling in Guessing Games: An Experimental Study." *American Economic Review* 85 (5): 1313–1326.

Nyarko, Y., and A. Schotter. 2002. "An Experimental Study of Belief Learning Using Elicited Beliefs." *Econometrica* 70 971–1005. 10.1111/1468-0262.00316.

Ochs, J. 1995. "Games with Unique, Mixed Strategy Equilibria: An Experimental Study." *Games and Economic Behavior* 10 (1): 202–17. 10.1006/game.1995.1030.

Osborne, M., and A. Rubinstein. 1998. "Games with Procedurally Rational Players." *American Economic Review* 88 (4): 834–847.

Osborne, M., and A. Rubinstein. 2003. "Sampling equilibrium, with an application to strategic voting." *Games and Economic Behavior* 45 (2): 434–444.

Palacios-Huerta, I., and O. Volij. 2009. "Field Centipedes." *American Economic Review* 99 (4): 1619–35. 10.1257/aer.99.4.1619.

Palfrey, T. R., and S. W. Wang. 2009. "On eliciting beliefs in strategic games." *Journal of Economic*

Behavior and Organization 71 (2): 98–109. 10.1016/j.jebo.2009.02.009.

Pearce, D. 1984. "Rationalizable Strategic Behavior and the Problem of Perfection." *Econometrica* 52 (4): 1029–1050. 10.2307/1911197.

Proto, E., A. Rustichini, and A. Sofianos. 2019. "Intelligence, Personality, and Gains from Cooperation in Repeated Interactions." *Journal of Political Economy* 127 (3): 1351–90. 10.1086/701355.

Rapoport, A., W. E. Stein, J. E. Parco, and T. E. Nicholas. 2003. "Equilibrium play and adaptive learning in a three-person centipede game." *Games and Economic Behavior* 42 (3): 239–65. 10.1016/S0899-8256(03)00009-5.

Renou, L., and K. Schlag. 2010. "Minimax regret and strategic uncertainty." *Journal of Economic Theory* 145 (1): 264–286.

Rey-Biel, P. 2009. "Equilibrium play and best response to (stated) beliefs in normal form games." *Games and Economic Behavior* 65 (2): 572–585. 10.1016/j.geb.2008.03.003.

Rubinstein, A. 2007. "Instinctive and Cognitive Reasoning: A Study of Response Times." *The Economic Journal* 117 (523): 1243–1259. 10.1111/j.1468-0297.2007.02081.x.

Rubinstein, A. 2016. "A Typology of Players: Between Instinctive and Contemplative." *Quarterly Journal of Economics* 131 (2): 859–90. 10.1093/qje/qjw008.

Schotter, A., and I. Trevino. 2021. "Is Response Time Predictive of Choice? An Experimental Study of Threshold Strategies." *Experimental Economics* 24 (1): 87–117. 10.1007/s10683-020-09651-1.

Spiliopoulos, L., and A. Ortmann. 2018. "The BCD of response time analysis in experimental economics." *Experimental Economics* 21 (2): 383–433. 10.1007/s10683-017-9528-1.

Stahl, D. O., and P. W. Wilson. 1994. "Experimental evidence on players' models of other players." *Journal of Economic Behavior and Organization* 25 (3): 309–327. 10.1016/0167-2681(94)90103-1.

Stahl, D. O., and P. W. Wilson. 1995. "On Players' Models of Other Players: Theory and Experimental Evidence." *Games and Economic Behavior* 10 (1): 218–254. 10.1006/game.1995.1031.

Weber, R. A. 2003. "'Learning' with no feedback in a competitive guessing game." *Games and Economic Behavior* 44 (1): 134–144. 10.1016/S0899-8256(03)00002-2.

Yerkes, R. M., and J. D. Dodson. 1908. "The relation of strength of stimulus to rapidity of habit-formation." *Journal of Comparative Neurology and Psychology* 18 (5): 459–482. 10.1002/cne.920180503.

Appendices

Appendix A. Supporting Tables and Figures

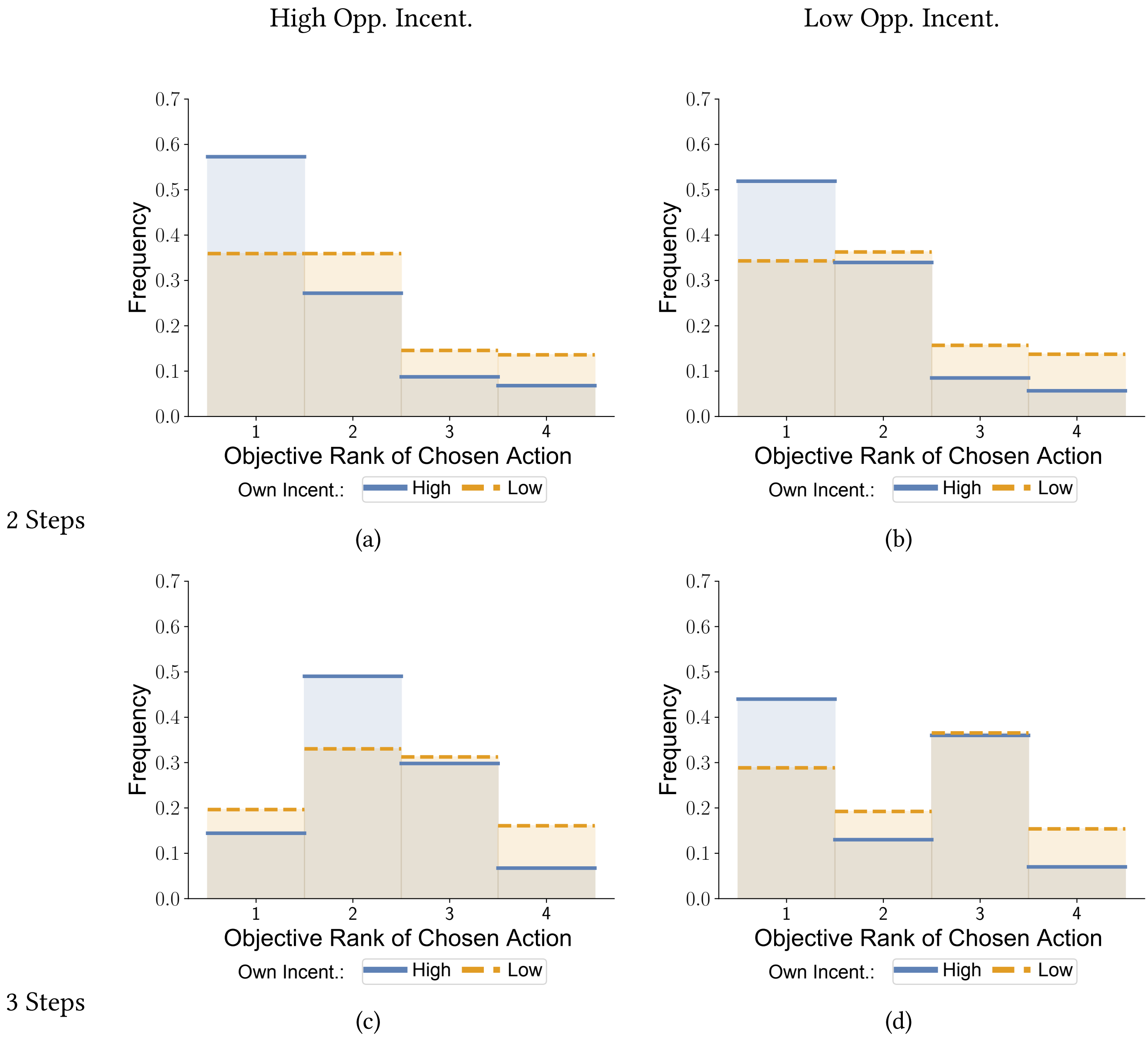


Figure 7: Incentive Level and Objective Mistakes (Hypothesis 2b)

Notes: The different panels exhibit the frequency of the objective rank of the action chosen by the participant for high and low own incentive levels, for different games (2 Steps, (a) and (b), and 3 Steps, (c) and (d)) and holding fixed the opponent's incentive level (High, (a) and (c), or Low, (b) and (d)). The objective rank of an action is n if the action entails the n-th highest objective expected payoffs according to the observed action frequency; e.g. actions with objective rank 1 are those that maximise (objective) expected payoffs. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1).

	a_1		a_2		a_3		a_4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2 Steps	3 Steps	2 Steps	3 Steps	2 Steps	3 Steps	2 Steps	3 Steps
Log(Response Time)	0.131***	0.024	-0.021	0.131***	-0.053*	-0.083**	-0.057**	-0.072***
	(0.033)	(0.025)	(0.032)	(0.029)	(0.022)	(0.028)	(0.021)	(0.020)
High Own Incent.	0.140**	-0.072	-0.050	0.110*	-0.041	0.030	-0.048	-0.068*
	(0.052)	(0.039)	(0.050)	(0.050)	(0.033)	(0.047)	(0.032)	(0.032)
High Opp. Incent.	0.004	0.005	-0.028	0.029	0.004	-0.047	0.020	0.013
	(0.048)	(0.038)	(0.048)	(0.048)	(0.032)	(0.046)	(0.028)	(0.032)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.17	0.05	0.07	0.13	0.08	0.10	0.08	0.12
N	414	420	414	420	414	420	414	420

Heteroskedasticity-robust standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 8: Action Frequency and Response Time

Notes: This table shows the results for the association between choice of a particular action a_n and response time (in seconds) and incentive level treatments, controlling for individual characteristics. Different columns refer to linear probability models relating the choice of an action in a game (2 Steps in columns (1), (3), (5), and (7); 3 Steps in columns (2), (4), (6), and (8)). Errors across regressions are correlated by construction and the table is to be taken as describing measures of association supporting the patterns described in Figure 5. High Own/Opponent Incentives correspond to indicators for whether the participant and their opponent face a high incentive level. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Controls refer to the participants' age, sex, education, and prior exposure to game theory.

	b_1		b_2		b_3		b_4	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	2 Steps	3 Steps	2 Steps	3 Steps	2 Steps	3 Steps	2 Steps	3 Steps
Log(Response Time)	0.049***	-0.022*	0.054***	0.019**	-0.045***	0.056***	-0.057***	-0.053***
	(0.010)	(0.009)	(0.010)	(0.007)	(0.008)	(0.011)	(0.006)	(0.008)
High Own Incent.	0.013	-0.013	0.014	0.007	-0.010	0.005	-0.017	0.001
	(0.016)	(0.014)	(0.016)	(0.011)	(0.012)	(0.018)	(0.011)	(0.012)
High Opp. Incent.	0.015	-0.017	-0.004	0.030**	-0.004	-0.004	-0.007	-0.010
	(0.016)	(0.014)	(0.016)	(0.011)	(0.012)	(0.018)	(0.010)	(0.012)
Controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.14	0.07	0.16	0.08	0.19	0.11	0.25	0.16
N	414	420	414	420	414	420	414	420

Heteroskedasticity-robust standard errors in parentheses.

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

Table 9: Beliefs and Response Time

Notes: This table shows the results for the association between belief b_n in opponents choosing a particular action a_n and response time (in seconds) and incentive level treatments, controlling for individual characteristics. Different columns refer to linear regressions relating the reported beliefs referring to a particular action in a given game (2 Steps in columns (1), (3), (5), and (7); 3 Steps in columns (2), (4), (6), and (8)). Errors across regressions are correlated by construction and the table is to be taken as describing measures of association supporting the patterns described in Figure 6. High Own/Opponent Incentives correspond to indicators for whether the participant and their opponent face a high incentive level. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Controls refer to the participants' age, sex, education, and prior exposure to game theory.

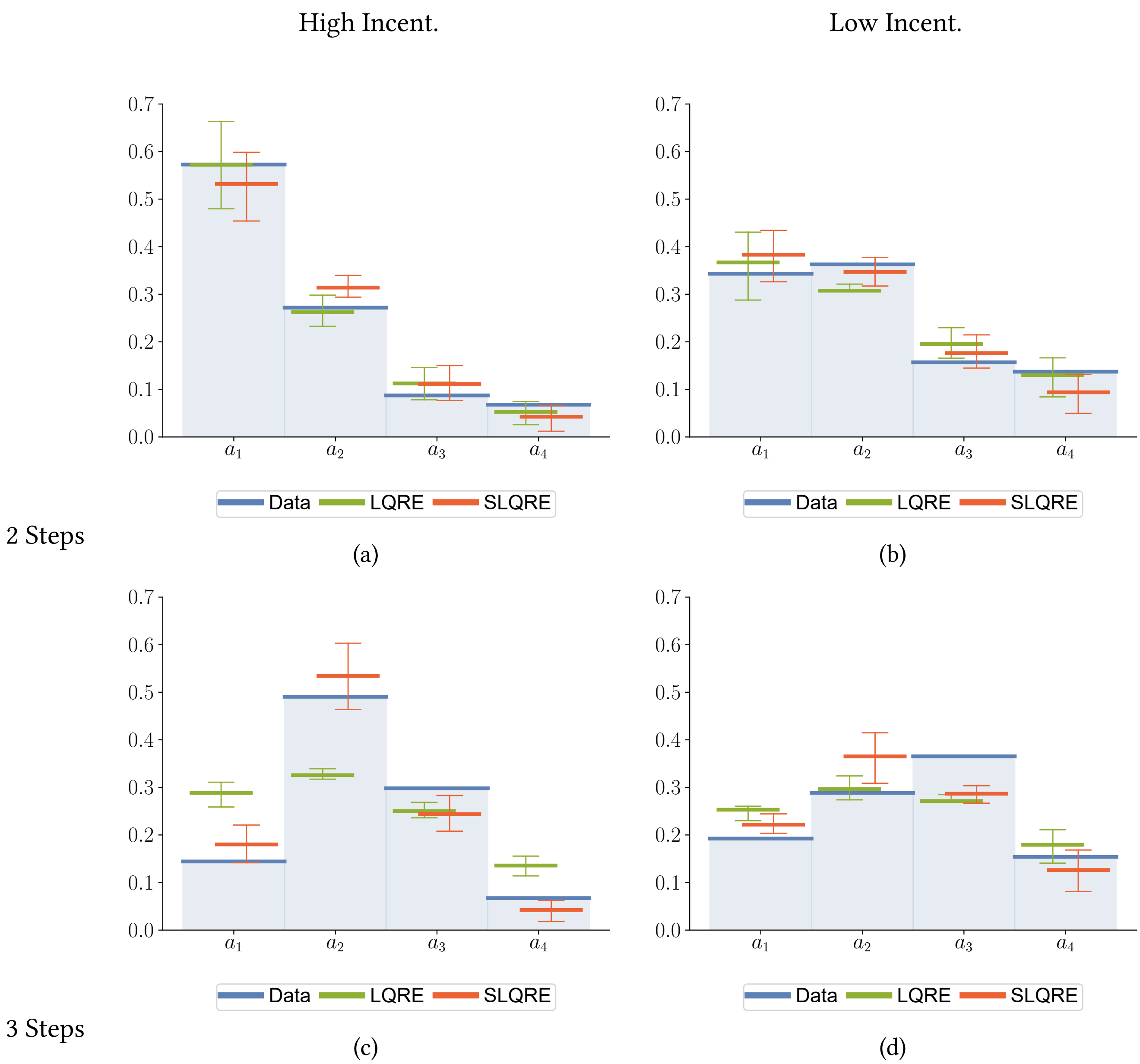


Figure 8: Logit Quantal Response Equilibrium: Maximum Likelihood Estimation

Notes: The different figure displays the empirical frequency of choices in the data (blue), the predicted choice frequencies obtain via maximum likelihood estimation of logit quantal response equilibrium (LQRE, green), and the predicted choice frequencies obtain via maximum likelihood estimation of subjective logit quantal response (SLQRE, red). Subjective logit quantal response corresponds to logistic multinomial regression using subjective expected payoffs according to participants' reported beliefs. Different panels correspond to different incentive levels (High, (a) and (c), and Low, (b) and (d)) and to different games (2 Steps, (a) and (b), and 3 Steps, (c) and (d)). We restrict observations to cases in which own and opponents' incentive levels are the same, since cases for which they do not match would correspond to off-equilibrium play. 2 Steps and 3 Steps denote the different games in the experiment (see Figure 1). Asymptotically consistent 95% confidence intervals obtained through bootstrapping with 10,000 replications are given for logit quantal response equilibrium choice frequencies (green whiskers) and for subjective logit quantal response (red whiskers).

Appendix B. On Alternative Explanations

Social or other-regarding preferences. This experiment was designed to study strategic sophistication in a setting where the participants' payoffs are not directly affected by the choices of others. This was done by using a one-shot game and by having participants' choices not directly affecting their opponents' payoffs. This is meant to reduce the potential for social preferences to affect behaviour, as participants are not directly affecting the payoffs of others, and so the behaviour of the participants' choices is more likely to be driven by the incentives they face rather than by other-regarding preferences. Consistent with this, we see that best-response rates to stated beliefs (maximising own payoffs) are high, whereas other-regarding predictions, such as choosing the action that maximises the sum of own and opponent's expected payoff is about half of the best-response rate and not explaining data better than uniform choice.

Regarding the comparison to other solution concepts, such as maximin choice, note that these do not depend on the incentive level the participant faces, and so we would not expect to see any differences across incentive levels as indeed we do.

Appendix C. Methodology and Experimental Design

The following section discusses some of the details and logic underpinning our design choices and methodology.

C.1. Participant Pool

Recruitment. After careful consideration of the different options available, we chose to run the experiment relying on an online participant recruitment platform such as Amazon's Mechanical Turk (MTurk) for two main reasons.

First, online platform participants face a more homogeneous opportunity cost of time as other tasks are readily available to take up and time here is very clearly money. This makes incentives more salient and mitigates concerns with false negatives due to participants being intrinsically motivated to perform well regardless of monetary compensation, as could be the case with onsite lab participants. We also expected online participants to be less likely to have strong other-regarding preferences than those in the lab.

Second, participants can exit the experiment at any moment, without any inconvenience for themselves or others. This is particularly important since the response time data was a substantial focus of the analysis. Instead, lab participants would (i) need to stay until the end of the experiment, removing much of the cost of taking longer, or (ii) would be able to leave early, disrupting others, or (iii) would need to come one by one, implying very significant time demands to recruit hundreds participants.

The preference for Amazon's Mechanical Turk (MTurk) as opposed to other platforms such as Prolific simply denotes common practice at the time and convenience. Experiments conducted on MTurk before the Spring of 2021 have since been replicated with Prolific participants without any substantial differences (see, e.g., Gonçalves et al., 2024).

Attention and Understanding. One of the main concerns with online experiments is that the data may be noisy due to inattention or misunderstanding of the tasks. However, several aspects of our data suggest that participants understood the tasks and were attentive. For instance, best-response rates to stated beliefs ranged from 40% to 50% with low own incentives and 60% to 70% with high own incentives. This is comparable to what has been observed in two-player two- and three-action games (ours have four actions) in the lab, e.g. Nyarko and Schotter (2002); Costa-Gomes and Weizsäcker (2008); Rey-Biel (2009), as well as more recent lab experiments as Friedman and Ward (2022), indicating that the participants understand the game. Moreover, participants spent, on average, between 1 and 2 minutes per round, indicating a reasonable degree of reflection and reasoning effort.

One of the main concerns with online experiments is that the data may be noisy due to inattention, which leads the participants to misunderstand the tasks. We believe our data suggests that participants did understand the tasks. For instance, note that best-response rates to stated beliefs range from 40 to 50% with own low incentives and 60 to 70% with high own incentives. This is comparable to what has been observed in two-player two- and three-action games (ours have four actions) in the lab, e.g. Nyarko and Schotter (2002); Costa-Gomes and Weizsäcker (2008); Rey-Biel (2009), as well as more recent lab experiments as Friedman and Ward (2022), and so it denotes that the participants seem to understand the game. Moreover, participants spend on average between 1 and 2 minutes in one round. This does seem a sensible amount of time which, together with the time spent on instructions, denotes reflection and reasoning effort.

The instructions were written to be as intuitive as possible. For example, participants were explicitly informed that they should report their true beliefs and that the accuracy of their guesses would determine their earnings. Participants were also given the opportunity to familiarise themselves with the game interface during the instructions.

We strove to inform participants of the experimental design and the incentives as clearly as possible to be transparent about the task they were asked to do, but we also tried to do it in a manner as intuitive as possible. We also gave the participants opportunity to familiarise themselves with the game environment, and so we encouraged them to interact with the interface of the game and see how it worked during the instructions. At the end the instructions there was a quiz to help participants consolidate their understanding of the experiment.

The average time spent on instructions was 12 minutes (median of 10 minutes), and attrition was low, further suggesting that at least a majority of the participants understood the task. Moreover, the fact that instructions were provided before revealing the incentive levels suggests that any "noise" in the data would be consistent across incentive levels, making it less likely to confound our treatment effects.

Incentives for Belief Reporting. One advantage of using probability points for belief elicitation is that it allows us to present the same game representation to participants, independent of payoffs. This design choice helps isolate the effects of incentives on behaviour while holding the underlying game structure constant.

Our experimental design induces incentive-compatible elicitation of both actions and beliefs under weak assumptions.

To achieve this, we (i) restricted the experiment to a single round to prevent non-feedback learning (Weber, 2003) and boredom, and (ii) paid participants for either their action choice or their belief report, but not both. This payment scheme minimises the potential for hedging between the two tasks, which could arise if participants are uncertain about the opponent's action distribution. By making the choice of which task to pay for independent of the payment level, we ensure incentive compatibility regardless of risk attitudes or uncertainty about the opponent's behaviour.

Online Appendices

Online Appendix A. Additional Tables and Figures

A.1. Sample Characteristics

The questionnaire asked basic demographic information: age, sex, education level, education field, and prior exposure to game theory. Participants' age ranged from 20 to 73 years olds, with an average of about 37 years and standard deviation of about 11 years with the distribution being right-skewed; 44.36% of the participants identified themselves as women and 55.64% as men. Reported education ISCED levels are presented in Table 10, and education fields in Table 11. 81% of the participants claimed to have no prior exposure to game theory, 11.15% had been exposed to game theory but outside an academic environment, and 7.89% had had formal training in game theory. We verified that the samples across treatments were balanced by relying on t-tests for means (age) and Fished-exact tests of independence (sex, education, and exposure to game theory).

	Education Level						
ISCED Level	≤2	3	4	5	6	7	8
Count	8	107	43	228	352	93	3

Table 10: Participants per Education ISCED Level

Notes: ISCED levels are as follows: ≤2: Incomplete high school or less; 3: High school; 4: Business, technical, or vocational school after high school; 5: Some college or university qualification, but not a bachelor, 6: Bachelor or equivalent; 7: Master or post-graduate training; 8: Ph.D.

Education Field	Count
Agriculture, Forestry, Fisheries and Veterinary	6
Arts and Humanities	128
Business, Administration and Law	146
Computer Science, Information and Communication Technologies	130
Economics	29
Education	42
Engineering, Manufacturing and Construction	34
Generic	107
Health and Welfare	54
Mathematics and Statistics	21
Natural Sciences	44
Services (Transport, Hygiene and Health, Security and Other)	39
Social Sciences and Journalism	54

Table 11: Participants per Education Field

Notes: This classification corresponds to ISCED field education classification, to which economics was added as a separate category.

Online Appendix B. Instructions and Interface

Below we reproduce screenshots with the instructions, practice rounds, the only main (incentivized) round, and the final questionnaire.

Instructions

WELCOME!

After you start the experiment, please focus and avoid multitasking or taking breaks.
Beyond the instructions, the task is extremely short.
This is extremely important for our research.

Please settle in and click the Start button to continue with the instructions.

Start

Introduction

Outline

You are about to participate in an experiment on the economics of decision-making.

You can take 5min or 45min completing this experiment: the time you take depends exclusively on how much effort you want to put in to make a good decision to get the bonus.
Just by completing the experiment, you will secure a **minimum of $2.00**.
You can earn up to a **maximum of $22.00** from this short experiment, depending on your performance.

You will begin, on the next screen, with the instructions. Please read them carefully.
At the end of the instructions there will be questions to check that you understand how the experiment works.
Upon answering these questions correctly, you will proceed to the main task.

The main task has one single round. Your payment will depend on your performance in the main task.
The goal of the experiment is to study how people reason and act in contexts of strategic interaction.

Before the main task begins there will be two practice rounds for you to familiarize yourself with the interface.

After the main task, there is a brief questionnaire.

'Bot'-Detection

This task is designed for humans and cannot be fulfilled using automated answers.

You will be asked to prove you are complying with this requirement by transcribing words at random points in this task. The text will be as legible as the text in these instructions. Any human able to read this text will be able to read the words for transcription, but a 'bot' will not.

You will be allowed 3 attempts and 1 minute per attempt. If you fail to transcribe a word three times, the task will be immediately terminated and you will not be able to complete it nor receive payment.

Quitting the Task

You can quit the task at any moment, but if you do not complete it you will not receive any payment.

Additional Information

In the experiment you will answer questions which ask you to choose between different options. Your responses to this experiment will be used to study how people choose when the outcome depends on others' choices as well.

No identifying data about you will be made available and all data we store will be anonymized. All data and published work resulting from this experiment will maintain your individual privacy.

Please understand that your participation in this experiment is voluntary. If you consent to participate, you have the right to withdraw consent or discontinue participation at any time. For additional details, see this information sheet.

Next

Instructions

Click on the section to show/hide.

Payoff Structure

In this experiment, you are going to be asked to make choices and predictions. Your bonus will depend on the choices and predictions you make and on how other participants choose.
How much you get from your choices depends on the payoff structure that defines your action payoffs.

A payoff structure describes how many "Action Points" each agent obtains depending on the actions chosen by the two agents.

		Orange			
		Action A	Action B	Action C	Action D
Blue	Action 1	10 60	20 30	40 20	70 10
	Action 2	90 10	80 70	20 70	40 20
	Action 3	20 20	50 80	10 40	20 90
	Action 4	30 30	40 10	50 60	80 80

For example, the above figure is a payoff structure.
There are two agents, **Blue** and **Orange**.
- Each row corresponds to an action that the **Blue** agent can take and each column corresponds to an action the **Orange** agent can take.
- The "Action Points" that agents obtain depend on what both choose.
Each cell corresponds a unique combination of a choice of an action (row) by **Blue** and the choice of an action (column) by **Orange**, determining the "Action Points" they get in that case.
In each row (column) you can see all the "Action Points" for the **Blue** (**Orange**) agent associated with choosing that row (column), which also depend on what **Orange** (**Blue**) agent chooses.

Blue's "Action Points" are blue and in the lower left corner of the cell.
Orange's "Action Points" are orange and in the upper right corner of the cell.

Example 1: If **Blue** chooses action 1 and **Orange** chooses action C, then **Blue** gets 20 "Action Points" and **Orange** gets 40 "Action Points".
Example 2: If **Blue** chooses action 2 and **Orange** chooses action C, then **Blue** gets 70 "Action Points" and **Orange** gets 20 "Action Points".
Both agents will have 4 actions they can choose from.

"Action Points" and Choices: Examples

Suppose you are **Blue**.
If you think **Orange** agents choose action A, then action 1 gives you the most "Action Points".
If instead you think **Orange** agents choose action B, then action 3 gives you the most "Action Points".
If you think that on average 50% of the **Orange** agents choose action B and 50% choose action C, then action 2 will give you the most "Action Points" on average.
What **Orange** agents do on average is often crucial to choose the action that gives you the most action points on average.
You can also think about **Orange**'s choices: **Orange** agents would never want to choose action C because no matter what they think **Blue** agents will do, another action delivers more "Action Points".
Also, **Orange** agents would only choose action A if they thought **Blue** agents are very likely to choose action 2.

You will now have a practice round to understand "hands-on" how your and the other agent's choices affect how many points you get.

Next

PRACTICE ROUND

		Orange			
		Action A	Action B	Action C	Action D
Blue	Action 1	70, 30	30, 70	40, 40	80, 20
	Action 2	30, 70	10, 90	20, 80	40, 40
	Action 3	40, 40	20, 80	30, 70	70, 30
	Action 4	80, 20	40, 40	70, 30	90, 10

Click to select your action.

You can only proceed after you provide a guess and select an action.

Instructions

Click on the section to show/hide.

Payoff Structure

Opponents

In the task, you will face a payoff structure.
Participants other than you will face the same payoff structure.

The **Other participants** are sorted into one of two groups:
- **HIGH STAKES** group; and
- **LOW STAKES** group.
Other participants in the **HIGH STAKES** group have a bonus of **$20.00**.
Other participants in the **LOW STAKES** group have a bonus of **$0.50**.
Some are **Blue** agents, others **Orange** agents.
Within each group, the **Other participants** are randomly matched with an opponent of a different color.
This means that **Other participants** always face opponents with **the same STAKES**.

The **Other participants**:
- Are asked (1) to *guess* what opponents (participants of different color) with **the same STAKES** choose on average and (2) to choose an *action*.
- Are compensated the same way as you are (details below), getting "Action Points" and "Guess Points".
- Do not know who they are matched with nor others' choices.

You will be a **Blue** agent and you will be randomly matched with an **Orange** opponent.
Your **Orange** opponent will be from either the **HIGH STAKES** group ($20.00 bonus) or the **LOW STAKES** group ($0.50 bonus) with equal probability.
You will have **HIGH STAKES** ($20.00 bonus) or **LOW STAKES** group ($0.50 bonus) with equal probability.
You may or may not have the same STAKES as your **Orange** opponent.

There are then four possible situations:

You have **HIGH STAKES** ($20.00 bonus) **Orange** opponent is from the **HIGH STAKES** group ($20.00 bonus)	**You** have **HIGH STAKES** ($20.00 bonus) **Orange** opponent is from the **LOW STAKES** group ($0.50 bonus)
You have **LOW STAKES** ($0.50 bonus) **Orange** opponent is from the **HIGH STAKES** group ($20.00 bonus)	**You** have **LOW STAKES** ($0.50 bonus) **Orange** opponent is from the **LOW STAKES** group ($0.50 bonus)

You will be asked:
1. To *guess* what your **Orange** opponents in the same STAKES group as your opponent choose on average; and
2. To choose an *action*.

Depending on how correct your guess is (details below), you will get "Guess Points".
Depending on **Your** action and your **Orange** opponent's action, you will get "Action Points" according to the payoff structure.
Your **Orange** opponent is matched to some other **Blue** participant, and therefore:
- **Your** action will not affect your **Orange** opponent's "Action Points";
- But your **Orange** opponent's actions does affect your "Action Points".

Before you make guesses and choose your action, you will be informed of:
- Your **Orange** opponent STAKE group;
- **Your** own STAKES.

"Action Points" and "Guesses Points"

You can get Points either from the actions you choose ("Action Points") or from your guesses as to what **Orange** opponents may do ("Guess Points").
The Points used to implement the **bonus** are either the "Action Points" or the "Guess Points", chosen randomly with equal probability.
You will only get Points from your actions or your guesses, not from both.

The "Action Ponts" you obtain depend **Your** action and your **Orange** opponent's action.
You will get "Action Points" according to the payoff structure.

The "Guess Points" you obtain depend on how accurate your guess is.
You are asked to guess the probability that **Orange** agents such as your opponent are to choose any given action.
If you guess correctly, you get 100 "Guess Points".
If you guess completely incorrectly, you get 0 "Guess Points".
The further away your guess is from the average of others' choices, the fewer "Guess Points" you get.

The rule that determines your "Guess Points" is set so that it is always in your best interest to state what you believe.

The exact rule that determines your points from your guess is as follows:
If y_i is the fraction of subjects who chose action $i = A, B, C, D$, and g_i is your corresponding guess divided by 100 -- so that both y_i and g_i are between 0 and 1 --,

$$\text{Guess Points} = 100 \times \left(1 - \frac{1}{2}\left((y_A - g_A)^2 + (y_B - g_B)^2 + (y_C - g_C)^2 + (y_D - g_D)^2\right)\right)$$

Points, Stakes and Bonus

The Points you get determine the probability with which you will get a **bonus**.
Example: if you get 75 Points, you will get the **bonus** with 75% probability and nothing with 25% probability.

How big the **bonus** is depends on the **STAKES** level you are assigned to.

The bonus for participants assigned to the **HIGH STAKES** level is of **$20.00**.
In this case: Points = Probability of getting a $20.00 bonus.

The bonus for participants assigned to the **LOW STAKES** level is of **$0.50**.
In this case: Points = Probability of getting a $0.50 bonus.

Every participant will be assigned to either the **HIGH STAKES** level or the **LOW STAKES** level randomly and with equal probability (50%-50%).

You should pay attention to whether you are in the **HIGH STAKES** level or the **LOW STAKES** level.
Mistakes and hasty decisions when you are assigned to the **HIGH STAKES** level may severely decrease the probability of getting the $20.00 bonus.
Mistakes and hasty decisions when you are assigned to the **LOW STAKES** level may severely decrease the probability of getting the $0.50 bonus.

It is important to know the following:

- The participants are randomly matched and no one knows others' choices or guesses.
No one knows who they are going to be matched with.

- Other participants have the same compensation scheme as you and observe the same payoff structure.
The order of the payoff structures and labels of the actions are randomized.

- **Your** choices do not affect your **Orange** opponent's "Action Points".
But your **Orange** opponent's action does affect **Your** "Action Points".

- Your **Orange** opponent, their opponent, their opponent's opponent, and so on, all have been assigned to the **same STAKES** group.
But **You** may or may not have been assigned to the same **STAKES** level as your **Orange** opponent.

- Participants are recruited under the same conditions as you.

- It is crucial to pay attention to **STAKES** level of your **Orange** opponent as well as the **STAKES** level **You** were assigned to.

The **STAKES** level determines the bonus.

Interface

This is how the interface looks like:

You have
HIGH STAKES ($20.00 bonus).

Your **Orange** opponent is from the
LOW STAKES group (**$0.50 bonus**).

You can only proceed after you provide a guess and select an action.
The payoff structure will appear momentarily.

		Orange			
		Action A	Action B	Action C	Action D
Blue	Action 1	10 60	20 30	40 20	70 10
	Action 2	90 10	80 70	20 70	40 20
	Action 3	20 20	50 80	10 40	20 90
	Action 4	30 30	40 10	50 60	80 80
	Probability Guess	%	%	%	%

What is the probability that **Orange** agents
in the LOW STAKES group ($0.50 bonus)
are to choose any given action?

The accuracy of your guess will determine your "Guess Points".

Use the sliders above to give your answer.

One **Orange** agent will be randomly selected as your opponent
from the LOW STAKES group ($0.50 bonus).

Your **Orange** opponent's action and **Your** action will determine your "Action Points".

Click to select your action.

Instructions

Duration and payments

The main task has ONLY ONE round plus 2 practice rounds.
The experiment concludes with a quick questionnaire.

We expect it takes you
< 10 min Instructions
20sec - 40 min Main task (depending on you entirely)

< 1 min Questionnaire
Total: 10-55 min.

You will get $2.00 just by completing the experiment.
You can get up to $22.00 depending on the **STAKES** level you are assigned to and how you perform on the main task.
Remember: hasty choices may substantially harm your chances of getting a high bonus.

Details on how the bonus is computed

At the start of the experiment, you will be randomly sorted into HIGH STAKES or LOW STAKES, with equal probability (50-50%).
The group of your opponent is then selected: HIGH STAKES group or LOW STAKES group, with equal probability (50-50%).
Your opponent is randomly chosen among all other participants in that group, with equal probability.

Your and your opponent's action choices determine your "Action Points" according to the payoff structure you both observe.
Your guess and the actions of participants (other than you) in the group your opponent is drawn from determine your "Guess Points" according to the formula above.

Randomly and with equal probability, either your "Action Points" or your "Guess Points" are chosen to determine your bonus.
A number y between 0 and 100, is generated uniformly at random (all numbers have equal probability).
If that number y is smaller than your Points, that is, with probability = Points (%) and you have **HIGH STAKES**, you get $20.00.
If that number y is smaller than your Points, that is, with probability = Points (%) and you have **LOW STAKES**, you get $0.50.
If that number y is larger than your Points, you get no bonus.

Next

Instructions

Click on the section to show/hide.

Payoff Structure

Opponents

"Action Points" and "Guesses Points"

Points, Stakes and Bonus

It is important to know the following:

- The participants are randomly matched and no one knows others' choices or guesses.
No one knows who they are going to be matched with.

- Other participants have the same compensation scheme as you and observe the same payoff structure.
The order of the payoff structures and labels of the actions are randomized.

- **Your** choices do not affect your **Orange** opponent's "Action Points".
But your **Orange** opponent's actions does affect **Your** "Action Points".

- Your **Orange** opponent, their opponent, their opponent's opponent, and so on, all have been assigned to the **same STAKES** group.
But **You** may or may not have been assigned to the same **STAKES** level as your **Orange** opponent.

- Participants are recruited under the same conditions as you.

- It is crucial to pay attention to **STAKES** level of your **Orange** opponent as well as the **STAKES** level **You** were assigned to.
The **STAKES** level determines the bonus.

Duration and payments

Details on how the bonus is computed

Questions

You must answer the following questions correctly before you can proceed.

Refer to the following hypothetical interface screenshot:

You have
HIGH STAKES ($20.00 bonus).

Your **Orange** opponent is from the
LOW STAKES group (**$0.50 bonus**).

You can only proceed after you provide a guess and select an action.
The payoff structure will appear momentarily.

		Orange			
		Action A	**Action B**	**Action C**	**Action D**
Blue	**Action 1**	10 60	20 30	40 20	70 10
	Action 2	90 10	80 70	20 70	40 20
	Action 3	20 20	50 80	10 40	20 90
	Action 4	30 30	40 10	50 60	80 80
	Probability Guess	%	%	%	%

What is the probability that **Orange** agents
in the LOW STAKES group ($0.50 bonus)
are to choose any given action?

The accuracy of your guess will determine your "Guess Points".

Use the sliders above to give your answer.

One **Orange** agent will be randomly selected as your opponent
from the LOW STAKES group ($0.50 bonus).

Your **Orange** opponent's action and **Your** action will determine your "Action Points".

Click to select your action.

Instructions

1.
What are your stakes?
- ○ High stakes.
- ○ Low stakes.

2.
What are your opponent's stakes?
- ○ High stakes.
- ○ Low stakes.

3.
How much is the high stakes bonus?

- $0.20.
- $0.50.
- $10.00.
- $20.00.

4. How much is the low stakes bonus?
   - $0.20.
   - $0.50.
   - $10.00.
   - $20.00.

5. If all the Orange agents choose action B, which action gives you the highest number of points?
   - Action 1.
   - Action 2.
   - Action 3.
   - Action 4.

6. If 80% of the Orange agents chooses action A and 20% chooses action D, which action gives you the highest number of points on average?
   - Action 1.
   - Action 2.
   - Action 3.
   - Action 4.

7. If 50% of the Blue agents choose action 1 and 50% choose action 2, which action gives the Orange agents the highest number of points on average?
   - Action A.
   - Action B.
   - Action C.
   - Action D.

8. Your opponent's action matters for your Action Points but your action does not affect your opponent's Action Points.
   - True.
   - False.

9. You are going to be randomly matched with a Orange agent. That Orange agent is going to be randomly matched with some other Blue agent.
   - True.
   - False.

10. Your opponent and your opponent's opponent (and so on) always have the same stakes level.
    - True.
    - False.

Check Answers

Captchas

Bot Detection - Attempt 1

Type the following word or phrase into the box below, then press 'Next'. Answers are not case-sensitive.
You have three attempts. If you fail all three attempts, the task will end and you will not be paid.
You have one minute per attempt.

Payoff Structure

Next

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Practice Rounds

PRACTICE

You will now play two rounds as a practice, to familiarize yourself with the interface.

Your choices and guesses in these rounds do not affect your pay.

Next

PRACTICE ROUND

You have
HIGH STAKES (**$20.00 bonus**).

Your **Orange** opponent is from the
HIGH STAKES group (**$20.00 bonus**).

You can only proceed after you provide a guess and select an action.
The payoff structure will appear momentarily.

PRACTICE ROUND

You have
HIGH STAKES ($20.00 bonus).

Your **Orange** opponent is from the
HIGH STAKES group (**$20.00 bonus**).

You can only proceed after you provide a guess and select an action.
The payoff structure will appear momentarily.

		Orange			
		Action A	Action B	Action C	Action D
Blue	Action 1	10 / 90	40 / 40	20 / 80	30 / 70
	Action 2	30 / 70	80 / 20	40 / 40	70 / 30
	Action 3	20 / 80	70 / 30	30 / 70	40 / 40
	Action 4	40 / 40	90 / 10	70 / 30	80 / 20
	Probability Guess	14.3%	65.5%	18.0%	2.2%

What is the probability that **Orange** agents
in the HIGH STAKES group ($20.00 bonus)
are to choose any given action?

The accuracy of your guess will determine your "Guess Points".

Use the sliders above to give your answer.

One **Orange** agent will be randomly selected as your opponent
from the HIGH STAKES group ($20.00 bonus).

Your **Orange** opponent's action and **Your** action will determine your "Action Points".

Click to select your action.

Click next to submit your choice and guess.
You will not be able to go back.

Next

Instructions

Main Task

MAIN TASK

The main experiment will now start.

By completing the experiment, you will secure a $2.00 completion fee,
(in addition to the bonus you may get) regardless of how well you do.

In addition to the completion fee, you can get a bonus depending on how well you do.
Remember that Points = Probability of getting the bonus.

The size of the bonus you can get depends on whether you are assigned to
- the **HIGH STAKES**, where you can get a **$20.00 bonus**; or
- the **LOW STAKES**, where you can get a **$0.50 bonus**.

You will be assigned to one of these with equal probability (50%-50%).
Click Next to find out which you've been assigned to.

Next

You are going to enter the MAIN TASK!

You have
HIGH STAKES (**$20.00 bonus**).
Your choices and guesses count towards a **$20.00 bonus**.

This is the only round.
Remember that Points = Probability of getting the bonus.

Your **Orange** opponent is from the
LOW STAKES group (**$0.50 bonus**).

By completing the experiment, you will secure a $2.00 completion fee,
(in addition to the bonus you may get) regardless of how well you do.
So be sure to complete the experiment to get the completion fee.

You have
HIGH STAKES (**$20.00 bonus**).

Your **Orange** opponent is from the
LOW STAKES group (**$0.50 bonus**).

You can only proceed after you provide a guess and select an action.
The payoff structure will appear momentarily.

You have
HIGH STAKES ($20.00 bonus).

Your **Orange** opponent is from the
LOW STAKES group (**$0.50 bonus**).

You can only proceed after you provide a guess and select an action.
The payoff structure will appear momentarily.

		Orange			
		Action A	Action B	Action C	Action D
Blue	Action 1	10 / 10	70 / 30	40 / 40	10 / 20
	Action 2	40 / 40	20 / 10	10 / 10	30 / 70
	Action 3	70 / 30	30 / 70	20 / 10	40 / 40
	Action 4	10 / 20	40 / 40	30 / 70	70 / 30
	Probability Guess	%	%	%	%

What is the probability that **Orange** agents
in the LOW STAKES group ($0.50 bonus)
are to choose any given action?

The accuracy of your guess will determine your "Guess Points".

Use the sliders above to give your answer.

One **Orange** agent will be randomly selected as your opponent
from the LOW STAKES group ($0.50 bonus).

Your **Orange** opponent's action and **Your** action will determine your "Action Points".

Click to select your action.

Instructions

Questionnaire

Questionnaire: Socio-Demographics

Please enter your age:

Please state your sex:

- Male
- Female

What is the HIGHEST LEVEL OF EDUCATION that you COMPLETED in school?

- None or Primary Education: Primary School (grades 1-6)
- Lower Secondary Education: Middle School or some High School incomplete
- Upper Secondary Education: High School
- Business, technical, or vocational school AFTER High School
- Some college or university qualification, but not a Bachelor
- Bachelor or equivalent
- Master or Post-graduate training or professional schooling after college (e.g. law or medical school')
- Ph.D or equivalent

Choose the field that best describes your PRIMARY FIELD OF EDUCATION.

- Generic
- Arts and Humanities
- Social Sciences and Journalism
- Economics
- Education
- Business, Administration and Law
- Computer Science, Information and Communication Technologies
- Natural Sciences
- Mathematics and Statistics
- Engineering, Manufacturing and Construction
- Agriculture, Forestry, Fisheries and Veterinary
- Health and Welfare
- Services (Transport, Hygiene and Health, Security and Other)

Did you ever learn Game Theory?

- Yes, as an graduate course.
- Yes, as an undergraduate course.
- Yes, as an online course, Summer school course or similar.
- Yes, for professional reasons.
- Yes, searching the web / out of personal interest.
- No.

Next

You must answer each question before you can continue.

Payment

Payment

As explained in the instructions, you will be paid a completion fee and a bonus.

The completion fee is made of $2.00 to be paid upon conclusion, regardless of how you did.
$0.50 out of the $2.00 completion fee will be paid immediately, as soon as your HIT is approved.
The remainder, $1.50, will be paid together with the bonus.
We expect to be quick (less than 48h) in approving and paying the bonus.

For the main task, you will be matched with another subject and the actions that you both chose in that game will determine how many points you will get from your choices.
How far off your guess is from the average choices of the other participants will determine how many points you will get from your guesses.
One the two will be chosen with equal probability as your final points.
Those points will then be used as the probability of winning a bonus corresponding to the stakes level you were assigned to.

As you were assigned to the HIGH STAKES level, your points count towards the probability of getting a $20.00 bonus.
You will earn the bonus with Probability (%) = Points.

For instance, if you make 90 points, you will earn the bonus with 90% probability.

We will now ask you to complete a comments section.

Click 'Next' to continue to the comments section.

Next