Communicating in a Coordination Game with Private Information*

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Abstract

We consider an experiment with a version of the Battle of the Sexes game with two-sided private information, preceded by a round of either one-way or two-way cheap talk. We compare different treatments to study truthful revelation of information and subsequent payoffs from the game. We find that individuals are largely truthful (about 80% overall) in revealing their types in both one-way and two-way cheap talk. Furthermore, the unique symmetric cheap-talk equilibrium in the two-way cheap talk game is played when the players fully reveal their information. However, they attain even higher payoffs in the game with one-way talk by choosing the desired coordinated outcome following truthful announcements, which deviates from the theoretical equilibrium.

Keywords: Battle of the Sexes, Private Information, Cheap talk, One-way, Coordination.

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1 INTRODUCTION

Organizations often face situations where it's crucial for members to choose a common action: selecting a candidate for a job opening, a programming language for a project, or a location for a new office building. However, preferences regarding these actions are not generally common knowledge (e.g., who is the preferred job market candidate: the search theorist or the trade economist?), and they can vary across agents. In such contexts, communication can be crucial for achieving the desired coordination. For example, executives and managers are often advised to improve communication (Smidts *et al*, 2001; Eisenberg and Witten, 1987), encouraged to conduct *360-degree reviews* (Yammarino and Atwater, 1997; Atwater and Waldman, 1998), and generally urged to facilitate "making the views of all stakeholders heard" (Scholes and Clutterbuck, 1998; Morsing and Schultz, 2006).

The purpose of our research is to test the intuitive hypothesis that increased communication is always efficiency-enhancing in situations with private information, particularly emphasizing the importance of "listening to all stakeholders." To investigate this, we design a simple strategic form game of coordination with private information and test, in a laboratory experiment, whether two-way communication is superior to one-way communication. In our experiment, participants can choose between two actions (X and Y) in a two-player game. There is common knowledge that taking different actions leads to the worst payoff, and player 1 prefers the outcome achieved with the profile (X, X), while player 2 prefers (Y, Y). However, the payoff for the player from her less profitable outcome is private information and can take one of two values, $v \in \{A, B\}$, where $0 < A < B$. Efficiency, or at least the principle of total payoff maximization, suggests that players should coordinate on the profile with the lower loss for the "damaged" player. However, choosing the efficient option is difficult because whether v_i is the low (A) or high (B) value is the player's private information.

To fix ideas on a concrete context, think of one of the examples with which we started. There is a team of researchers where some people prefer word processing in LaTeX, versus other commercial software. Similarly, they may want to choose between conducting statistical analysis in Stata or R. It may be clear who prefers what software, but the loss to the party using the less preferred alternative could be private information, and this can make coordinating on the outcome that is efficient for the group more complicated. There are three treatments varying in the degree or availability of communication. In the two treatments with communication, participants can choose a message from A and B, and actions are chosen only after some communication ensues. In one-way communication, only one (randomly chosen) player can send a message, while, in two-way communication, both players choose a message simultaneously. After the player(s) send the message(s), both players choose actions. Additionally, we employ a benchmark treatment without communication, where participants directly choose actions.

There are at least two possible benchmarks against which we can compare our experimental results. First, we can compute the most informative symmetric Bayesian-Nash equilibrium with purely self-interested and consequentialist players, who care only about their own final payoffs and are Bayes-rational. We will call this the *standard prediction*. One potential alternative assumes it is common knowledge that players always send truthful messages (possibly because they incur a cost for lying), and otherwise, they are standard Bayes-rational and self-interested. We will call this the *truthful prediction*.

Under one-way communication, these two predictions diverge. The *truthful prediction* states that the player who sends the message announces her type truthfully; the players then play actions corresponding to an equilibrium of a reduced Bayesian game in which the sender's type is common knowledge, while the receiver's type remains private information. The *standard prediction*, on the other hand, is that, in equilibrium, one of two scenarios occurs: either the messages are independent of the players' types and at the action stage, the players play the Bayesian-Nash equilibrium of the game without communication, or the players' actions are independent of their messages, even if they are true reports.

Under two-way communication, these two predictions coincide (as shown in Ganguly and Ray, 2023), under certain parametric restrictions. The most informative symmetric Bayesian-Nash equilibrium of the game posits that both players announce their types truthfully. If the two announced types differ, the players then play actions leading to the efficient outcome; when both players announce the same type, they use the symmetric (and thus mixed) equilibrium in the corresponding subform.

One important implication of players following the *truthful prediction* is that there is no possibility of miscoordination, and thus the expected payoffs for both players would be larger under one-way than two-way communication. The results of our experiment can be summarized as follows. In the game with one-way communication, the observed behavior aligns statistically with the *truthful prediction*. Generally, senders are honest, and receivers respond accordingly.

Thus, the *standard prediction* is rejected. Players do not use the same message, and they do not ignore the sender's message after communicating. In the game with two-way communication, both the common standard and truthful predictions hold remarkably well. Both players tell the truth a very high percentage of the time, and, conditional on truth-telling, their subsequent actions align closely with the prediction.

However, an important implication of our observations is that aggregate payoffs are significantly higher under one-way communication than under two-way communication, and both are higher than those without communication. This contradicts the *standard prediction*, but aligns with the *truthful prediction* as mentioned earlier.

Our finding that payoffs are higher under one-way than two-way communication seems superficially related to previous experimental research on cheap-talk games under complete information, such as Cooper *et al* (1989). However, they are fundamentally different in nature. In games with complete information, as Cooper *et al* (1989) noted, "the sender of the message simply chooses his preferred equilibrium and the receiver best responds." In our game, when the sender in one-way communication tells the truth, she gets her worst outcome (of the coordinated outcomes) when she is of the High type; and this is why telling the truth is not an equilibrium. Yet, this is what we observe in our experiment, and it is the reason why one-way communication yields overall higher payoffs. This is indeed remarkable, because straightforward logic from experiments with complete information would suggest that the sender should pretend to be of Low type to achieve her preferred outcome.

1.1 Related literature

Many economically significant games involve multiple (pure) Nash equilibria, making it crucial to understand how, if at all, players coordinate to achieve a particular equilibrium outcome. This problem of equilibrium selection has been theoretically analyzed using various criteria, such as payoff-dominance (Colman and Bacharach, 1997) or risk-dominance (see Harsanyi and Selten, 1988, and Straub, 1995, for experimental evidence).

The experimental literature indicates that in coordination games with multiple equilibria, players often fail to coordinate (Van Huyck *et al*, 1991; Cooper and John, 1988; Straub, 1995) unless the game possesses specific features, like a strong form of risk-dominance (Cabrales *et al*, 2000). It is also well-known, since the work by Cooper *et al* (1989), that cheap-talk (Farrell, 1987) and, in general, pre-play non-binding communication can significantly improve coordination in experiments with games like Battle of the Sexes (see Crawford, 1998; Costa-Gomes, 2002; Burton *et al*, 2005, for details and Ochs, 1995, for a survey). In contrast with this existing literature, we focus on games with private information, which are very realistic in many contexts; however, coordination is severely threatened in them due to the players' incentive problems. There is limited evidence on coordination with incomplete information; most of it concentrates on the effect of adding public information about a common state (McKelvey and Page, 1990; Marimon and Sunder, 1993; McCabe *et al.*, 2000; Heinemann *et al.*, 2004; Cabrales *et al.*, 2007; Cornand and Heinemann, 2008) in the spirit of global games (Carlsson and Van Damme, 1993; Morris and Shin, 1998, 2002) and on the effect of sunspots (Duffy and Fisher, 2005). Our experiment focuses on the problem of coordination when the incomplete information concerns private, not common, values. Other literature (Moreno and Wooders, 1998; Cason and Sharma, 2007; Duffy and Feltovich, 2010; Bone *et al.*, 2024a,b; Anbarci *et al.*, 2018; Duffy *et al.*, 2017; Georgalos *et al.*, 2020) has experimentally shown that communication and play recommendations can achieve correlated equilibria (Aumann, 1974, 1987). This literature does not feature communication about players' payoffs under asymmetric information which is our main concern.

Cooper and Brandts (2025) study an environment that shares some features with ours: coordinating on a common action benefits all agents, agents have divergent preferences over possible outcomes, and there is private information about the efficient outcome. They introduce managers who also lack the necessary information to simply impose efficient coordination but have the power to enforce outcomes. They explore whether managerial control or delegation dominates, and whether free form, structured, or no communication is a better option. It is a richer environment than ours, but they also find that delegation often leads to miscoordination, even with communication. That said, managerial control can improve coordination because, as in our experiment, the participants do not lie excessively and the manager achieves coordination. We obtain similar results without needing managerial control: one-sided communication is an alternative (possibly cheaper) path to achieve efficient coordination. A different strand of experimental literature focuses on analyzing sender-receiver games *à la* Crawford and Sobel (1982). A relevant result from that literature (e.g., Dickhaut *et al.*, 1995; Blume *et al.*, 1998, 2001; Kawagoe and Takizawa, 1999) is that players tend to behave according to the informative equilibrium when their interests are well-aligned. Duffy and Feltovich (2002) explain why cheap talk or observation is likely to be more effective for achieving good outcomes in certain 2 x 2 games.

Our game is one where the players' interests do not align and thus is closer to another strand of the literature (Sánchez-Pagés and Vorsatz, 2007; Kawagoe and Takizawa, 2005; Cai and Wang, 2006; Wang *et al.*, 2010), which finds that senders sometimes tell the truth even when it is not in equilibrium.[1] Blume, Lai, and Lim (2023) have recently demonstrated that overcommunication and lying aversion diminish with experience. Duffy and Feltovich (2006) observe that senders' signals tend to be truthful in games played repeatedly against changing opponents, while Capraro (2017) shows that even in a one-shot interaction, time pressure increases honest behavior. An exception to the above is Cabrales *et al.* (2020), who also find evidence of aversion to lying, but in addition, a substantial amount of deception/misinformation occurs even when lying does not increase the sender's payoff; this happens more often among subjects who display non-pro-social or envious preferences, which they measured independently.[2] One notable paper contributing to this literature is Abeler *et al* (2019). They conduct a meta-analysis of previous experiments, along with some new ones, to explain why people sometimes tell the truth even against their own material interest. They conclude that "only combining a preference for being honest with a preference for being seen as honest (or a model whose intuition and prediction are very similar) can explain the data."

2 EXPERIMENT

2.1 Game

We consider the following two-person Bayesian game in which each player has two pure strategies, namely, X and Y:

$1\backslash 2$	X	Y
X	$1, v_2$	$0, 0$
Y	$0, 0$	$v_1, 1$

Table 1: Battle of the Sexes with private information

[1] Although, Gneezy (2005) finds deception for message-senders who could benefit materially from it. In ultimatum games with private information, Kriss *et al.* (2013) also observe very high frequencies of dishonesty.

[2] Agranov and Schotter (2012) show that in coordination games where players' interests are not aligned, it is sometimes useful for a utilitarian third party to communicate types to the players in a vague manner.

where v_i are independent random variables taking two values, $\{A, B\}$, with $A < B$ and p being the probability of B; v_i is private information for player i, $i = 1, 2$. Players receive a positive payoff only when they coordinate their strategies on either X or Y.

We study an extended game in which the players first engage in a round of cheap talk, where they may reveal their private information about the value of v_i, before playing the above Battle of the Sexes (henceforth, BoS). If the communication is two-way, players simultaneously report a value of v_i before playing the game; if it is one-way, only one player reports her type. At the end of the game, payoffs are calculated according to Table 1, based on the realized values of v_i.

In the communication stage of this game, an announcement strategy for player i is thus a function $a_i : \{A, B\} \to \Delta(\{A, B\})$, where $\Delta(\{A, B\})$ is the set of probability distributions over $\{A, B\}$. With some abuse of notation, one may write $a_i(B\,|v_i\,)$ for the probability that strategy $a_i(v_i)$ of player i with valuation v_i assigns to the announcement B.

In the two-way communication game, during the action stage, a strategy for player i is a function $\sigma_i : \{A, B\} \times \{A, B\} \times \{A, B\} \to \Delta(\{X, Y\})$, where $\Delta(\{X, Y\})$ is the set of probability distributions over $\{X, Y\}$. We write $\sigma_i(X\,|v_i; \tau_1, \tau_2\,)$ for the probability that strategy $\sigma_i(v_i; \tau_1, \tau_2)$ of player i, with valuation v_i, assigns to the action X given the communication stage announcements (τ_1, τ_2). Similarly, in the one-way communication game, the strategy of player i with valuation v_i is $\sigma_i(v_i; \tau)$, which assigns a probability to the action X when the communication stage announcement is τ.

2.2 Theoretical Benchmark

Ganguly and Ray (2023) demonstrate that there exists a unique fully revealing symmetric perfect Bayesian equilibrium in this two-way communication game for a range of values of p. In this equilibrium, known as $S_{separating}$, the players announce their types truthfully, i.e., $a_i(B\,|B\,) = 1$ and $a_i(B\,|A\,) = 0$, for $i = 1, 2$. In the action stage, when both players' types are identical, each player plays the mixed Nash equilibrium strategies of the complete information BoS, where player 1 plays X with probability $1/\,(1 + v_2)$ and player 2 plays Y with probability $1/\,(1 + v_1)$. When only player 1's value is B (A), they play the coordinated outcome (Y, Y) $((X, X))$. Theorem 1 in Ganguly and Ray (2023) confirms that $S_{separating}$ is the unique fully revealing symmetric perfect Bayesian equilibrium, and it exists if and only if

$$\frac{A^2 + A^2B}{1 + A + A^2 + A^2B} \leq p \leq \frac{AB + AB^2}{1 + A + AB + AB^2}. \tag{1}$$

In the game with one-way communication, it can be shown that there are multiple asymmetric equilibria; players may engage in babbling during the cheap-talk stage, meaning they report the same value (or distribution over values) regardless of the original value and then play any of the equilibria of the BoS. Also, in the game with one-way cheap talk, truthfully revealed messages followed by actions that meaningfully depend on those messages are no longer equilibrium profiles (Theorem 3 in Ganguly and Ray, 2023).

2.3 Alternative Benchmark

An alternative benchmark could assume that players behave as in Kartik (2009) and incur a cost for lying. In our case, with only two types, this means they would experience a disutility of value κ, if the message differed from their true type. This would not change the prediction from $S_{separating}$ in the two-way communication game, since in that equilibrium, players are already announcing the truth. It would just add a cost to deviating in the first stage. On the other hand, the prediction is significantly different with one-way communication. With this assumption about preferences, it can now be an equilibrium for the sender to announce her type truthfully, i.e., $a_i(B\,|B) = 1$ and $a_i(B\,|A) = 0$, for $i = 1, 2$. Then, in the action stage, we assume both players use a coordinated efficient outcome, given the announced type of the sender. That is, when the sender 1's announced type is B (A), they play the coordinated outcome (Y, Y) ((X, X)), and when the sender 2's announced type is B (A), they play the coordinated outcome (X, X) ((Y, Y)),

Clearly, at the action stage, the players do not have an incentive to deviate in this alternative equilibrium. Also, when the sender is 1 and the true type is A, the sender does not have a material incentive to deviate in the message stage. On the other hand, she might be tempted to claim her type is A when it is actually B. The monetary gain from such a deviation would be $1 - B$. This strategy would not be optimal if $\kappa > 1 - B$. Under this assumption, a truth-telling efficient equilibrium emerges in the one-way game, which we call $S_{onewaytruth}$. (see subsection 2.5 below for details).

2.4 Parameters

We set $A = 0.65$ and $B = 0.9$, and $p = 0.4$. Throughout the paper, we refer to a player of type-A as Low-type when $v_{i.} = 0.65$, and of type-B as High-type when $v_{i.} = 0.9$. For simplicity, four possible type profiles or states are denoted by AA, AB, BA, and BB, respectively. Thus, the game can be presented with four different type profiles, as shown in Table 2 below.

State AA (both players are of type-A)

	X	Y
X	$1, 0.65$	$0, 0$
Y	$0, 0$	$0.65, 1$

State AB (player 1: type-A; player 2: type-B)

	X	Y
X	$1, 0.9$	$0, 0$
Y	$0, 0$	$0.65, 1$

State BA (player 1: type-B; player 2: type-A)

	X	Y
X	$1, 0.65$	$0, 0$
Y	$0, 0$	$0.9, 1$

State BB (both players are of type-B)

	X	Y
X	$1, 0.9$	$0, 0$
Y	$0, 0$	$0.9, 1$

Table 2: The Bayesian game with two types for each player

Our choice of parameter values offers several advantages. First, the values of A and B are significantly distinct. Second, condition 1 (as stated in subsection 2.2) holds for these values of A and B, ensuring that the fully revealing symmetric strategy profile is a perfect Bayesian equilibrium ($S_{separating}$). Furthermore, the states AB and BA occur frequently enough, given our choice of p;[3] the combined probability of these two states is $2p(1-p) = 0.48$, which is sufficiently large for our purposes.

Under the equilibrium strategy $S_{separating}$, the players coordinate on (X, X) ((Y, Y)) in state AB (BA) and play the mixed Nash equilibrium when their types are identical. In the AA state, player 1 plays X (and by symmetry, player 2 plays Y) with probability $20/33$ ($\simeq 0.61$), while in the BB state, player 1 plays X (and player 2 plays Y) with probability $10/19$ ($\simeq 0.53$). Thus, $S_{separating}$ generates the following distribution (as shown in Table 3) over the outcomes, with the expected payoff for each player being $17598/26125$ ($\simeq 0.67$).[4]

[3] We know (Ganguly and Ray, 2023) that the upper bound of p in Equation 1 is always strictly less than 0.5.

[4] We present the approximate values (up to 2-decimal points) for the equilibrium distribution in Table 3 for the ease of comparison with our experimental findings (see Tables 7 and 8 in subsection 3.2 below). The actual

	X	Y		X	Y		X	Y		X	Y
X	0.24	0.37	X	1	0	X	0	0	X	0.25	0.28
Y	0.15	0.24	Y	0	0	Y	0	1	Y	0.22	0.25
State AA			State AB			State BA			State BB		

Table 3: The two-way cheap-talk equilibrium distribution

As evident from Table 3, the equilibrium $S_{separating}$ results in a significant amount of miscoordination (i.e., the outcomes (X, Y) or (Y, X)) when the types are the same (approximately 52% in the AA state and 50% in the BB state).

Given our parameter values, the unique symmetric Bayesian-Nash equilibrium of the BoS without communication can be easily computed (see Proposition 1 in Ganguly and Ray, 2023 for details). In this pure symmetric equilibrium, player 1 of type-A plays X, and type-B plays Y (symmetrically, player 2 of type-A plays Y and type-B plays X). Thus, the players fully coordinate (on either (X, X) or (Y, Y)) when their types differ, but miscoordinate (choosing (X, Y) or (Y, X)) when their types are the same. The expected payoff for each player in this equilibrium is 0.456.

2.5 Reduced Games (One-way)

The original Bayesian game, as shown in Table 2, can be reduced under one-way communication when the communicating player reveals the type truthfully (as under the benchmark discussed in subsection 2.3). In this case, we have a reduced Bayesian game with one-sided private information, where one of the players has two types. For example, consider when player 1 truthfully reports being of type-B; then the reduced game will have two types, A and B, for player 2 only, as shown in Table 4 below.

Player 2: type-A			Player 2: type-B		
	X	Y		X	Y
X	$1, 0.65$	$0, 0$	X	$1, 0.9$	$0, 0$
Y	$0, 0$	$0.9, 1$	Y	$0, 0$	$0.9, 1$

Table 4: The reduced Bayesian game with player 1 as type-B

probabilities are the products of the individual mixing probabilities; for example, in the AA state, the probability of the outcome XX is $\frac{20}{33}$ x $\frac{13}{33} = \frac{260}{1089} \simeq 0.24$.

This Bayesian game, understandably, has multiple equilibria. It is indeed easy to verify that the profiles $(X; X, X)$ and $(Y; Y, Y)$ are both pure Bayesian-Nash equilibria. Additionally, the mixed strategy profile given by $(\frac{20}{33}X; \frac{7}{57}X, X)$, in which player 1 plays X with probability $\frac{20}{33}$ (Y with $\frac{13}{33}$) and player 2 with type-A plays X with probability $\frac{7}{57}$ (Y with $\frac{50}{57}$), while type-B plays the pure strategy X, is also a Bayesian-Nash equilibrium of this game.

Similarly, when player 1 is of type-A, the set of equilibria for the corresponding reduced Bayesian game (with player 1 as type-A and player 2 with two possible types, A and B) consists of the pure profiles $(X; X, X)$ and $(Y; Y, Y)$ and the mixed profile given by $(\frac{10}{19}X; Y, \frac{65}{66}X)$.

By symmetry, using the above analysis, one can also easily determine the corresponding sets of equilibrium profiles for the two other reduced games in which player 2 is of a specific type (A or B) but player 1 has private information, with two types (A and B).

We now consider a natural equilibrium selection for these reduced games, based on coordination. We call this equilibrium $S_{onewaytruth}$ (as mentioned in subsection 2.3). Formally, $S_{onewaytruth}$ is the strategy profile in which (i) when player 1 is the announcer and is of type-A, player 1 truthfully announces A and the players subsequently play the profile $(X; X, X)$, (ii) when player 1 is the announcer and is of type-B, player 1 truthfully announces B and the players subsequently play the profile $(Y; Y, Y)$, (iii) when player 2 is the announcer and is of type-A, player 2 truthfully announces A and the players subsequently play the profile $(Y, Y; Y)$, and (iv) when player 2 is the announcer and is of type-B, player 2 truthfully announces B and the players subsequently play the profile $(X, X; X)$.

Notice that since there is no possibility of miscoordination under $S_{onewaytruth}$, the expected payoffs for both players are larger under $S_{onewaytruth}$ than those under $S_{separating}$.

2.6 Hypotheses

Given our chosen parameters, we expect to observe the equilibrium $S_{separating}$ in the two-way communication and the equilibrium $S_{onewaytruth}$ in one-way communication (under the alternative benchmark). For both cases, we do not expect any difference in truth-telling between the two types of players within a given game and between the two (one-way and two-way) communication treatments. This aligns with the existing literature mentioned earlier on truth-telling, even when it is not part of an equilibrium in the one-way communication game (under a more conventional theoretical benchmark as in subsection 2.2).

Our main hypothesis regarding the players' behavior in the two-way communication treatment is straightforward, as stated below.

Hypothesis 1 *Players follow the fully revealing symmetric perfect Bayesian equilibrium strategy, that is, they report their values truthfully and then choose the actions in* $S_{separating}$ *in the two-way communication treatment.*

Note that, under Hypothesis 1, the outcomes in the game are as in Table 3.

We now focus on one-way communication and hypothesize the expected outcome in this treatment. As explained earlier, such a game has multiple (Bayesian-Nash) equilibria; however, one may naturally select the equilibrium $S_{onewaytruth}$, which is stated more formally below.

Hypothesis 2 *In the one-way communication treatment, the players play the strategy under* $S_{onewaytruth}$ *that is (i) when the row (column) player truthfully announces the low value,* 0.65*, then the players coordinate on the equilibrium strategy profile* $(X; X, X)$ $((Y, Y; Y))$*, while (ii) the players coordinate on the equilibrium strategy profile* $(Y; Y, Y)$ $((X, X; X))$ *if the row (column) player truthfully announces the high value,* 0.90*, in the corresponding reduced Bayesian game in which only the column (row) player has private information with two types.*

Our hypothesis regarding the players' behavior in the no communication game is that the players follow the unique Bayesian-Nash equilibrium strategy of the game as described earlier in subsection 2.4.

Hypothesis 3 *In the no communication treatment, the row (column) player plays the pure strategy* X (Y) *when the value* v_i *is* 0.65 *and the pure strategy* Y (X) *when the value* v_i *is* 0.90*.*

One may easily calculate the expected payoff of a player from the chosen equilibria in different treatments under our Hypotheses 1, 2 and 3. As mentioned in subsection 2.4, $S_{separating}$ generates an expected payoff of 0.67 (approximately) for each player, whereas the expected payoff for each player from the Bayesian-Nash equilibrium of the game (without communication) is 0.456. It can be checked that, under Hypothesis 2, the expected payoff of a player in the one-way treatment is 0.905.

Note that under Hypothesis 2, the players fully coordinate on either (X, X) or (Y, Y) equilibrium in the game, for all type-profiles in the one-way treatment; however, in the two-way communication treatment, they do not fully coordinate when their types are the same under Hypothesis 1, following the equilibrium strategy $S_{separating}$. Also, the players miscoordinate in the no communication treatment when their types are the same, under Hypothesis 3, following the Bayesian-Nash equilibrium of the game.

This leads us to our final hypothesis regarding the level of coordination (measured by the sum of (X, X) and (Y, Y)) and the payoffs achieved by the players in the game.

Hypothesis 4 *Coordination on either (X, X) or (Y, Y) equilibrium and thus the individual payoffs in the game are higher in the one-way communication than in the two-way communication treatment; these in turn are higher in two-way communication than the no communication treatment.*

Hypothesis 4 suggests that in our set-up, communication helps the players to achieve more coordination and payoffs; however, it's better to allow one-way communication.

2.7 Design and Procedures

Our experiment consists of three treatments which differ in the communication possibilities: two-way communication, one-way communication and no communication. In each of our treatments, we ran two sessions with 24 subjects; in total, 144 students participated in 6 sessions. The subjects were asked to choose what to announce in the communication stage and what to play in the game in the action stage, as described in the model above.

We used a "between subjects" design, where each participant took part in only one session and thus only in one treatment. For each of these sessions, we used 3 matching groups, each comprising 8 subjects (i.e., 4 pairs) in order to increase the number of independent observations. Each of these matching groups represents an independent observation; hence, we have a total of 6 independent observations per treatment. The overview of the experimental design is summarized in Table 5 below.

Treatment (Comm.)	#Subjects	#Ind. Obs.	#Periods	#Realized Obs. (type-A)	#Realized Obs. (type-B)
Two-way	48	6	20	576	384
One-way	48	6	20	576	384
None	48	6	20	576	384

Table 5: Summary of the experimental design

Each treatment lasted for 20 rounds. We randomly re-matched the subjects in every round in order to create an environment as close as possible to a one-period interaction between subjects. Subjects were informed that they had been randomly paired with participants, but they did not know the identity of those they were matched with. The same matching protocol was applied across all groups.[5]

All sessions followed an identical protocol. At the start, subjects were seated and the experimenter read the instructions aloud to everyone. They were then given a few minutes to complete a brief comprehension test (see Appendix) to ensure they understood the instructions. Once the test was completed, we checked with each subject individually to confirm they had the correct answers. The experiment did not begin until every subject answered correctly. Subjects were not allowed to communicate with each other during the session, except through their decisions in the experiment.

At the start of a round, subjects were shown the payoff matrix for the game and the value of v_i (A or B). For any treatment, the *same* random sequence of values was used in all sessions to minimize variation across subjects. After deciding on an action, subjects received feedback on their own announcement (depending on the treatment), chosen action, counterpart's announcement (depending on the treatment), counterpart's chosen action, their own payoff, and their counterpart's payoff after each round. Subjects were not presented a history of the game; however, they were given a record sheet in which they could write down their previous decisions, the decisions of their counterparts, and their own payoffs (see Appendix for details).

At the end of round 20, the experimental session ended. Subjects were asked to complete a brief on-screen questionnaire with some supplementary private (anonymous) information and were then privately paid according to their point earnings from all 20 rounds. We used an

[5]In this paper, all our non-parametric tests are based on the averages of relevant variables for each treatment within the matching groups.

exchange rate of £1 per point. Sessions lasted, on average, 45 minutes. The average payment across all treatments was about £11 (approximately \$15; equivalent to £15 per hour, or \$20) which is higher than student jobs in the UK that offer about £10.00 − £12.00 per hour currently.

The experiment was programmed and conducted with *z-Tree* (Fischbacher, 2007) at the laboratory of the Centre for Experimental Economics (EXEC) at the University of York. Subjects were recruited using the ORSEE software (Greiner, 2015) from various fields of study, including, but not limited to, Economics or other Social Sciences, at the University of York.

3 RESULTS

We organize our statistical analysis into subsections below based on the hypotheses stated above.

3.1 Truthfulness

The first question we are interested in is the truthfulness of the individuals when reporting their types in the communication treatments. We find that the proportion of truthful behavior is fairly high. Table 6 provides the proportion of truthful reports by all individuals (of two different types, as both row and column players) in the two-way and one-way communication treatments. Evidently, for the one-way communication treatment, we only considered the announcers (as either row or column players).

	Individual Truthfulness					
	Two-way Communication			One-way Communication		
Type	Yes	No	Total	Yes	No	Total
A	459 (80%)	117 (20%)	576	240 (82%)	54 (18%)	294
B	290 (76%)	94 (24%)	384	147 (79%)	39 (21%)	186
Total	749 (78%)	211 (22%)	960	387 (81%)	93 (19%)	480

Table 6: Truthfulness in all individual reports (by types and by treatments)

Table 6 shows that individuals are generally truthful (about 80% across types and communication treatments), aligning with the literature on truth-telling mentioned earlier in subsection 1.1. It also indicates that there is little difference between the two types and between the two

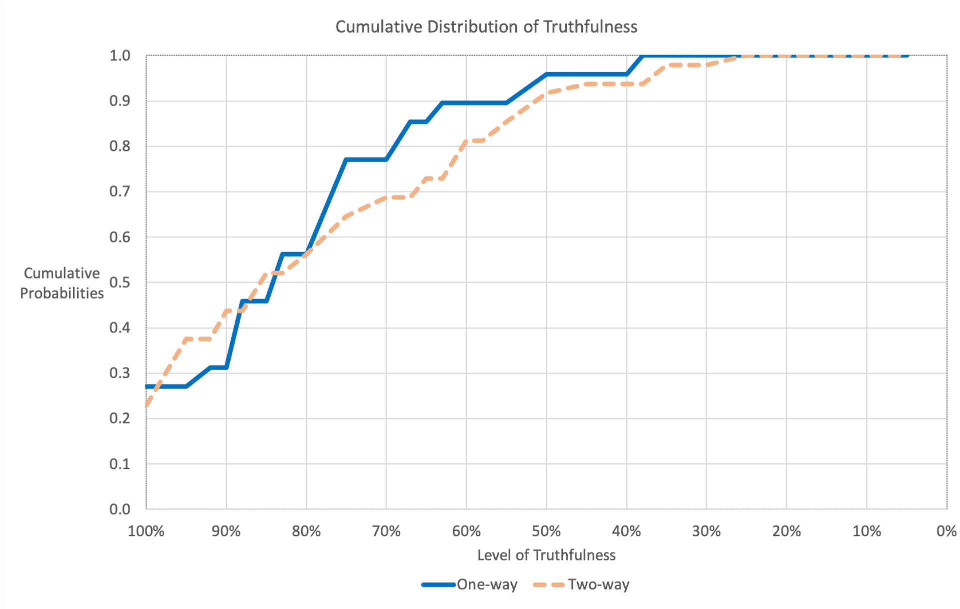


Figure 1: Truthfulness among individuals in one-way and two-way communication

communication treatments.[6] Using paired data, we also examine truthfulness within a pair in the two-way communication treatment and find that in 61% of the pairs, both individuals are truthful, while in another 34%, one of them is truthful. Figure 1 demonstrates the cumulative distribution of truthfulness in one-way and two-way communication treatments. In the two-way treatment, 11 (out of 48 individuals) are completely (100%) truthful which is also the modal frequency in the corresponding frequency distribution of individual truthfulness. The median individual is 85% truthful, with 25 out of 48 individuals reporting their true types in at least 17 out of 20 rounds. Meanwhile, the one-way treatment shows a similar distribution, where 13 out of 48 individuals are completely truthful. This is again the modal frequency, and the median individual is 83% truthful.

Result 1 *Individuals are overall truthful in reporting their types during the cheap talk phase, regardless of their private values, in both one-way and two-way communication treatments.*

[6]We use the chi-squared test to compare our observations. We fail to reject the null hypothesis that there are no significant differences between the truthfulness of different types (A vs. B) within one-way or two-way treatments, with corresponding p-values of 0.483 and 0.127 respectively. We also compare overall truthfulness per treatment, as well as per type in each treatment (Type A in one-way vs two-way, and Type B in one-way vs two-way), and we fail to reject the null hypothesis that there are no significant differences, with corresponding p-values of 0.254, 0.495, and 0.353 respectively. We confirm the same results with Fisher's exact test.

3.2 Equilibrium Play in Two-way Communication

We test Hypothesis 1 by examining whether individuals played $S_{separating}$ in our two-way communication treatment. Under $S_{separating}$, after truthfully revealing their types, players coordinate on the pure Nash equilibria, (X, X) and (Y, Y), in the AB and BA states. In the AA state, the equilibrium strategy is X (Y) with a probability of $1/1.65 \simeq 0.61$ for the row (column) player, while in the BB state, it is X (Y) with probability $1/1.9 \simeq 0.53$ for the row (column) player (see Footnote 4 in subsection 2.4).

We examine the data organized by individual truthfulness, given Result 1. Table 7 below shows the choices individuals made in the game for the two-way communication treatment, compared with the theoretical prediction in $S_{separating}$ under truthfulness. Individuals seem to play the equilibrium strategy within $S_{separating}$ when truthful, as shown in the top half of Table 7. For instance, when reporting their types truthfully, type-A row (column) player plays X (Y) in 62% (56%) of cases if the counterpart's report is A (which may or may not be true), compared to the theoretical equilibrium of 61% (the chi-squared test fails to reject the null hypothesis that our experimental data follows the equilibrium predictions, $\chi^2(1) = 0.01$ (0.545), $p = 0.899$ (0.460)). Similarly, type-B column player plays Y in 58% of cases if the counterpart's report is B, compared to the theoretical equilibrium of 53% (the chi-squared test fails to reject the null hypothesis that our experimental data follows the equilibrium predictions $\chi^2(1) = 0.365$, $p = 0.546$). However, for row players in the BB state, the data significantly diverges from the equilibrium prediction at the 5% level ($\chi^2(1) = 5.111$, $p = 0.024$). Moreover, type-B (A) individuals as the row (column) player choose to play Y in 95% (93%) of cases if the counterpart's reported type is A (B) compared to the theoretical equilibrium of 100%. Since the theoretical benchmark of 100% represents an extreme distribution, we employ a binomial test instead of chi-squared test. The results indicate that the observed data is statistically indistinguishable from a 95% benchmark.

True Talk	Value	Counterpart Talk		Row Player		Column Player	
				X	Y	X	Y
Yes	A	A	Expt	89/144 (62%)	55/144 (38%)	57/130 (44%)	73/130 (56%)
			Theory	61%	39%	39%	61%
	A	B	Expt	86/102 (84%)	16/102 (16%)	6/83 (7%)	77/83 (93%)
			Theory	100%	0%	0%	100%
	B	A	Expt	4/76 (5%)	72/76 (95%)	65/82 (79%)	17/82 (21%)
			Theory	0%	100%	100%	0%
	B	B	Expt	24/68 (35%)	44/68 (65%)	27/64 (42%)	37/64 (58%)
			Theory	53%	47%	47%	53%
No	A	A	Expt	10/32 (31%)	22/32 (69%)	31/37 (84%)	6/37 (16%)
	A	B	Expt	12/22 (55%)	10/22 (45%)	6/26 (23%)	20/26 (77%)
	B	A	Expt	9/19 (47%)	10/19 (53%)	19/33 (58%)	14/33 (42%)
	B	B	Expt	16/17 (94%)	1/17 (6%)	5/25 (20%)	20/25 (80%)

Table 7: Choices made in the game by all individuals in two-way communication

Additionally, Figure 2 focuses on the truthful subsample (both participants in a pair are truthful) and shows that truthful individuals coordinate on (X, X) and (Y, Y) in the AB and BA states, respectively. We observe that individuals aim to coordinate on the desirable Nash outcome when their types differ; for example, the second bar from the top indicates that the type-B row player plays Y in 95% of cases when the counterpart is type-A.

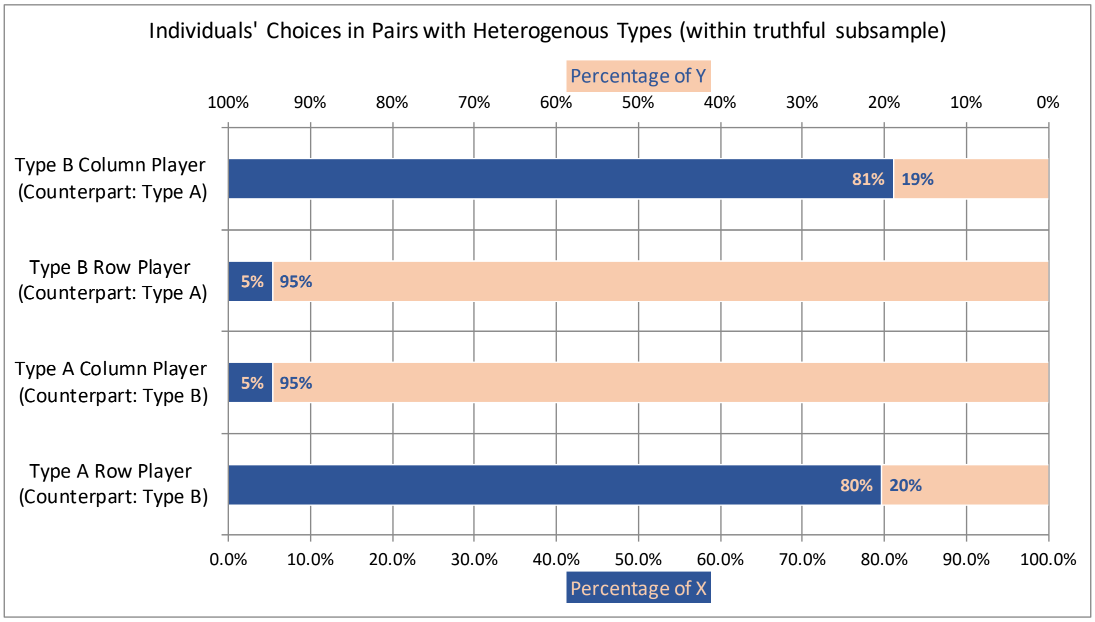


Figure 2: Individuals' play in two-way communication (within truthful pairs)

We also test Hypothesis 1 for all possible type profiles (AA, AB, BA and BB) by examining whether the observed distribution of outcomes matches the theoretical equilibrium distribution outlined in Table 3. The null hypothesis states that the observed frequencies follow the specified expected distribution. Table 8 reports the observed distributions for the truthful (both individuals are truthful) and non-truthful sub-samples, along with the results of the corresponding tests.[7] Based on the p-values, we conclude that our experimental data significantly diverges from our equilibrium predictions in all the non-truthful samples. In contrast, for the truthful samples, the observed frequencies do not significantly differ from the equilibrium predictions for the AA and BB type profiles, and only marginally for the for the BA profile. There is a significant quantitative difference with theory for the AB profile, but the qualitative direction is good.

[7]For AA and BB profiles, we used chi-squared goodness of fit test to test against the theoretical expectations. For AB the BA profiles, the theoretical benchmark of 100% in coordinating on the XX or YY outcomes respectively represent an extreme distribution, therefore we employ a binomial test where we check the number of observations of XX or YY against a benchmark of 90% to 99% instead of the chi-squared test. The p-values presented in these two cases correspond to the binomial test against a 95% benchmark.

Paired Types	Outcomes					GoF tests
	XX	XY	YX	YY	Total	p-value
AA (Theory Eqm)	24%	37%	15%	24%	100%	
AA (Both Truthful)	34 (29%)	40 (34%)	17 (14%)	27 (23%)	118	0.674
AA (Not Truthful)***	27 (40%)	18 (26%)	4 (6%)	19 (28%)	68	0.004
AB (Theory Eqm)	100%	0%	0%	0%	100%	
AB (Both Truthful)***	46 (67%)	9 (13%)	10 (14%)	4 (6%)	69	0.000
AB (Not Truthful)***	11 (24%)	12 (28%)	11 (24%)	11 (24%)	45	0.000
BA (Theory Eqm)	0%	0%	0%	100%	100%	
BA (Both Truthful)*	0 (0%)	3 (5%)	3 (5%)	50 (90%)	56	0.060
BA (Not Truthful)***	7 (21%)	7 (21%)	8 (23%)	12 (35%)	34	0.000
BB (Theory Eqm)	25%	28%	22%	25%	100%	
BB (Both Truthful)	9 (18%)	11 (22%)	13 (26%)	17 (34%)	50	0.307
BB (Not Truthful)*	9 (22%)	7 (18%)	7 (18%)	17 (42%)	40	0.074
Note: * denotes significance at 10% level, ** at 5% level and *** at 1% level.						

Table 8: Equilibrium predictions and experimental data for two-way communication[8]

Result 2 *Individuals' choices in the two-way communication treatment are relatively consistent with the equilibrium strategy when they are truthful during the cheap talk phase, and we find support for our main equilibrium Hypothesis* 1*.*

3.3 Play in One-way Communication

We now present the data for the one-way communication treatment, examining the choices made by the players, divided into two parts: one for the announcers and the other for the listeners.

[8]The tests for goodness-of-fit are conducted by pooling all observations for all subjects and periods. Further tests with independent observations are presented later.

In Table 9, we present the frequencies of announcers' choices within the one-way treatment, alongside the theoretical predictions according to the equilibrium in the corresponding reduced games mentioned in Hypothesis 2.[9] For the truthful subsample, as a row (column) player, type-A plays X (Y) (88%) and type-B plays Y (X) (87%) on average, aligning well with our hypothesis of equilibrium selection for this treatment (as stated in Hypothesis 2). Pooling all observations for all subjects and all periods, we check whether equilibrium predictions for the truthful announcer are significantly different from experimental observations using a binomial test, with the null hypothesis that the observed distribution does not significantly differ from the theoretical distribution. Our results indicate that the observed data is statistically indistinguishable from a 90% benchmark.[10]

Value		Truthful	Row [Column] Player	
			X [Y]	Y [X]
A	Experiment	No	21/54 (39%)	33/54 (61%)
		Yes	210/240 (88%)	30/240 (12%)
	Theory		100%	0%
B	Experiment	No	33/39 (85%)	6/39 (15%)
		Yes	19/147 (13%)	128/147 (87%)
	Theory		0%	100%

Table 9: Equilibrium and choices of announcers in one-way communication[11]

We now consider the listeners' choices to verify the behavior outlined in Hypothesis 2. Table 10 presents the listeners' choices (by type) following the counterpart's announcements, along with the equilibrium predictions as in Hypothesis 2. The choices made by the listeners broadly

[9] Note that there is only one announcer in this treatment, with 480 announcements, of which 387 are truthful, as reported in Table 6.

[10] Since the theoretical benchmark of 100% represents an extreme distribution, we employed a binomial test, where we checked against a benchmark of 90% to 99%. The results indicate that the observed data is statistically indistinguishable from a 90% benchmark based on the p-values of 0.196 and 0.269 for truthful type-A and type-B respectively.

[11] Using the symmetric nature of the game, note that the frequencies are total frequencies for X and Y depending on whether the player is a Row or Column Player, i.e. the frequency of X for Row Players are pooled with frequency of Y for Column Players and vice versa for each type.

support Hypothesis 2. Given the counterpart's announcement, listeners play an equilibrium strategy in a majority of the cases regardless of their own type.

Counterpart's, i.e. Announcer's		Own, i.e. Listener's			
			Value	Choice - Theory Choice	
Role	Announcement			X [Y]	Y [X]
Row [Column]	A	Experiment	A	114/172 (66%)	58/172 (34%)
			B	87/107 (81%)	20/107 (19%)
		Theory	A/B	100%	0%
	B	Experiment	A	10/110 (9%)	100/110 (91%)
			B	15/91 (16%)	76/91 (84%)
		Theory	A/B	0%	100%

Table 10: Equilibrium choices of the listeners in one-way communication (given the counterpart)[12]

Tables 9 and 10 indicate that following truthful announcements by the announcers, specific equilibrium profiles of the corresponding reduced games are played as indicated in Hypothesis 2. For example, when a row player truthfully announces type A, they play X, and then the listener, as a column player, plays X regardless of their own type, resulting in the equilibrium strategy profile $(X; X, X)$ in this reduced game.

We now present the actual outcomes of the game achieved in this treatment in Table 11. Table 11 indicates that following truthful announcements, players tend to coordinate on the pure Nash equilibria ((X, X) and (Y, Y)) of the game as suggested by our Hypothesis 2. Although playing the truthful, fully revealing profile is not an equilibrium in the one-way communication treatment, players are indeed truthful and do conform to a Bayesian-Nash equilibrium of the corresponding reduced game with one-sided private information.

[12] Using the symmetric nature of the game, note that the frequencies are total frequencies for X and Y depending on whether the player is a Row or Column Player, i.e. the frequency of X for Row Players are pooled with frequency of Y for Column Players and vice versa for each type.

Announcer's			Outcomes				
Role	Ann.	Case	XX $[YY]$	XY $[YX]$	YX $[XY]$	YY $[XX]$	Total
Row [Column]	A	All	173 (62%)	48 (17%)	50 (18%)	8 (3%)	279
		Truthful	146 (61%)	43 (18%)	45 (19%)	6 (2%)	240
		Theory	100%	0%	0%	0%	
	B	All	8 (4%)	30 (15%)	19 (9%)	144 (72%)	201
		Truthful	2 (1%)	18 (12%)	14 (10%)	113 (77%)	147
		Theory	0%	0%	0%	100%	

Table 11: Equilibrium predictions and experimental outcomes for one-way communication

Result 3 *In the one-way communication treatment, individuals play a particular Bayesian-Nash equilibrium in the reduced game with one-sided private information, if the announcer is truthful. When the row (column) player announces "type A", the players adopt the strategy profile* (X, X) $((Y, Y))$; *when the row (column) player announces "type B", the players choose* (Y, Y) $((X, X))$.

3.4 Play without Communication

We now present our results for the no communication treatment and thereby test our Hypothesis 3. We ask whether individuals indeed played the unique Bayesian-Nash equilibrium of the game without communication. Table 12 shows the choices made by the individuals of different types in the no communication treatment, along with the theoretical equilibrium.

Value		Row Player			Column Player		
		X	Y	Total	X	Y	Total
A	Expt	213 (71%)	87 (29%)	300	107 (39%)	169 (61%)	276
	Theory	100%	0%		0%	100%	
B	Expt	89 (49%)	91 (51%)	180	146 (72%)	58 (28%)	204
	Theory	0%	100%		100%	0%	

Table 12: Choices made in the game with no communication

Table 12 suggests that the Bayesian-Nash strategies are only weakly followed; for example, row (column) players with type A (B) play the pure strategy X in more than 71% of cases, which aligns with the equilibrium (pure) strategy. However, in other cases, the frequencies do not necessarily match the corresponding equilibrium strategies.

We test whether the observed distribution over the outcomes differs from the theoretical equilibrium distribution for all possible type profiles (i.e., Hypothesis 3). Table 13 presents the observed distributions and the results of the corresponding goodness of fit tests for different type profiles (AA, AB, BA, and BB). Based on the p-values, we conclude that our experimental data significantly (at the 1% level) differ from the predicted outcome distribution for all states.

Paired Types	Outcomes					p-value
	XX	XY	YX	YY	Total	
AA (Theory Eqm)	0%	100%	0%	0%	100%	
AA (Observed)***	56 (30%)	73 (39%)	19 (10%)	38 (21%)	186	0.000
AB (Theory Eqm)	100%	0%	0%	0%	100%	
AB (Observed)***	61 (53%)	23 (20%)	19 (17%)	11 (10%)	114	0.000
BA (Theory Eqm)	0%	0%	0%	100%	100%	
BA (Observed)***	17 (19%)	33 (37%)	15 (16%)	25 (28%)	90	0.000
BB (Theory Eqm)	0%	0%	100%	0%	100%	
BB (Observed)***	29 (32%)	10 (11%)	37 (41%)	14 (16%)	90	0.000

Note: * denotes significance at 10% level, ** at 5% level and *** at 1% level.

Table 13: Equilibrium predictions and experimental data for no communication

Result 4 *In the no communication treatment, observed outcomes differ significantly from those predicted under the unique Bayesian-Nash equilibrium of the game.*

Based on the analysis in this subsection and Result 4, we do not find strong evidence to support our Hypothesis 3 that players play the unique Bayesian-Nash equilibrium in the game without communication. However, in some cases (such as row and column players with type A and B), players modal choice is in accordance to the equilibrium strategy. We do not have a good explanation for why equilibrium fails more in this case. One possibility is that the absence of communication complicates a player's inference about the other player's intentions. Communication, combined with the (correct) assumption that most people are truthful in this environment, might make beliefs more precise.

Result 4 stands in stark contrast to Results 2 and 3, which indicate that players adhere to equilibrium behavior in games with communication. The following subsection explores this contrast in greater detail.

3.5 Coordination and Payoffs

Having analyzed individuals' truthfulness and strategies in the one-way and two-way communication games, we now focus on the payoffs for different treatments, both with and without communication. Evidently, payoffs are positively correlated with the level of coordination on the Nash equilibrium outcomes ((X, X) and (Y, Y)) in the game. Table 14 reports the frequencies of all outcomes chosen in the game.

Treatments	XX	XY	YX	YY	Total
Two-way	143 (30%)	107 (22%)	73 (15%)	157 (33%)	480
One-way	183 (38%)	102 (22%)	45 (9%)	150 (31%)	480
No Comm	163 (34%)	139 (29%)	90 (19%)	88 (18%)	480
Total	489 (34%)	348 (24%)	208 (14%)	395 (28%)	1440

Table 14: Frequencies of outcomes in the game for different treatments

Table 14 shows the level of coordination in the game, measured by the proportion of Nash equilibrium outcomes ((X, X) and (Y, Y)). The percentage of coordination is highest in the one-way communication treatment (69%), followed by the two-way treatment (63%), while the percentage in the no communication treatment is only 52%. Figure 3 presents the percentages of coordination ((X, X) and (Y, Y)), over 20 periods, divided into four equal five-period blocks for the three different treatments.

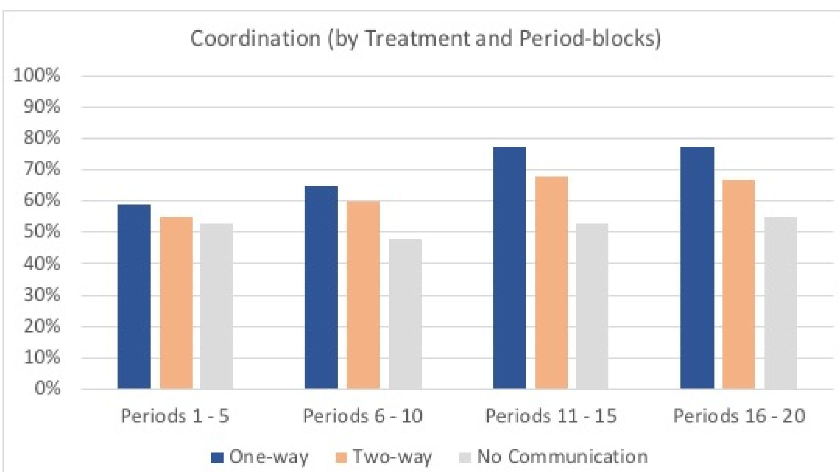


Figure 3: Frequencies (in percentages) of coordination over period blocks by treatments

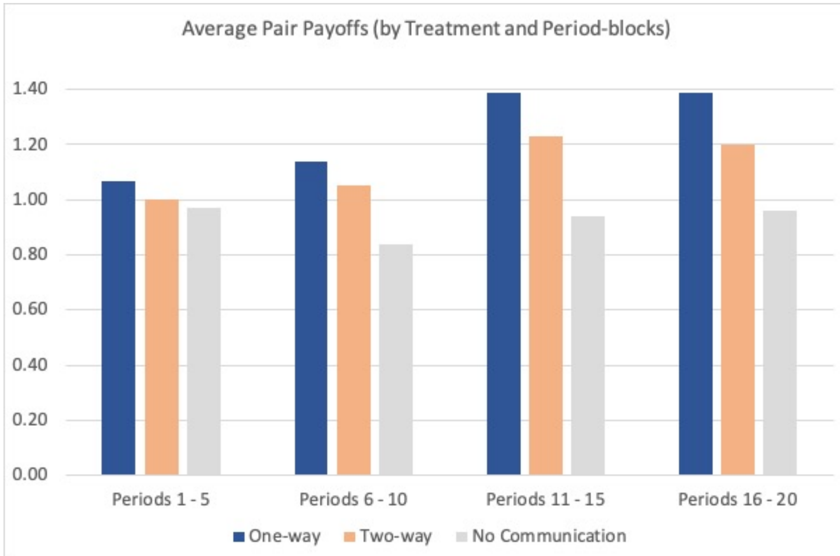


Figure 4: Average payoffs for a pair of players in the game over period blocks by treatments

We now present the actual payoffs in the game similarly. Figure 4 above mimics Figure 3 and shows the average payoffs for a pair (sum of payoffs for two players), over 20 periods, divided into four equal five-period blocks for the three different treatments.

These two figures show differences among the three treatments, especially from periods 11 to 20. For the comparison of coordination levels (average percentages per treatment and block period are shown in Figure 3), the results of the Mann-Whitney test, using pooled data, show that the difference between one-way and no-communication treatments is significant at the 1% level for periods 6 to 20 (with p-values being 0.0093, 0.0001, and 0.0004 for the blocks of periods $6-10$, $11-15$, and $16-20$, respectively). Again, for periods 6 to 20, we find significant differences between two-way and no communication treatments at the 5% to 10% level (with p-values of 0.0703, 0.0123, and 0.0647 for the blocks of periods $6-10$, $11-15$, and $16-20$, respectively). Finally, the difference between one-way and two-way communication is subtle, with a significant difference between these two treatments for the last block of periods $(16-20)$ at the 10% level (with a p-value of 0.0863).

The differences between the treatments comparing pair payoffs (averages per treatment and per block period are shown in Figure 4) are more prominent. The results of the Mann-Whitney test, using pooled data, show that the differences between one-way and no communication are again significant at the 1% level for periods 6 to 20 (with p-values of 0.0003, 0.0000, and

0.0000 for the blocks of periods $6-10$, $11-15$, and $16-20$, respectively). This time, we find significant differences between two-way and no communication treatments at the 1% to 5% level (with p-values of 0.0145, 0.0004, and 0.0001 for the blocks of periods $6-10$, $11-15$, and $16-20$, respectively). Additionally, we find significant differences between one-way and two-way communication at the 10% and 5% level for periods 11 to 20 (with p-values of 0.0737 and 0.0273 for the blocks of periods $11-15$ and $16-20$, respectively).

Additionally, we use a Kruskal-Wallis equality-of-populations rank test and find these three treatments are significantly different from each other (p-value = 0.0051). Using a similar test for each pair of treatments, we also find that each pair is significantly different (at least at the 10% level); the p-value for the comparison of no communication and one-way is 0.0039, the corresponding p-value for no communication and two-way is 0.0374, and the p-value for one-way and two-way is 0.0782. All these significance levels are even stronger for periods $11-20$ only; for example, the p-value in this case (periods $11-20$ only) for comparing one-way and two-way is now 0.0374, indicating that the payoffs are higher in the one-way communication treatment than the two-way treatment.

Result 5 *By using cheap talk, individuals coordinate more in the game and thus achieve higher payoffs. Coordination and payoffs increase over time and are the highest in the one-way communication treatment.*

Based on Result 5 above, we accept our Hypothesis 4 that cheap talk helps players achieve more coordination and thereby higher payoffs in the game. We also show that one-way communication achieves the best results in this respect.

4 Conclusion

We performed an experiment using a version of the Battle of the Sexes game with two-sided private information. The main aim was to compare the outcomes when the game is played after either one-way or two-way cheap talk, as well as with no communication. We find that players are generally truthful about their types during the cheap-talk phase in both one-way and two-way communication. This behavior aligns with equilibrium behavior in the two-way treatment but not under one-way communication. We find that payoffs are highest with one-way communication. This occurs because, in our setup, possibly due to a cost of lying, one-way communication facilitates easier coordination. When the sender is expected to be mostly truthful (which can happen if most people have a degree of lying aversion), it is clear how to efficiently coordinate: when the sender is high type, she gives in, and when she is low type, the receiver gives in. In fact, most participants do this. In two-way communication, when types coincide, there is no clear way to coordinate, often leading to miscoordination. This is what we observe in our experiment.

This is an important result, as it suggests that maximum communication does not always enhance efficiency under private information. It would be interesting to explore whether this holds for other classes of games, such as those where coordination is not the primary driver of payoffs.

Our paper fits into the existing literature, as there is a tension between truth-telling norms and fairness preferences or inequality aversion in our context, which seems to resolve in favor of truth-telling. This is likely due to repetition, as participants are not always on the "losing" side of the coordination game.

Note that our results are obtained in an environment where it is difficult to establish a reputation for reliability and trustworthiness. The game is repeated 20 times with a group of 8 people, and participants are not informed who they are meeting each time. We expect these results to be even stronger in the context of a long-lived organization where actors have an incentive to establish themselves as trustworthy partners (Wilson and Sell, 1997). The literature on "promises," as discussed in Ellingsen and Johannesson (2004), and Charness and Dufwenberg (2006, 2013), shows that individuals in a partnership often make and keep promises to perform actions that are not beneficial to themselves, to persuade others to join the partnership. This behavior seems to be driven by "guilt aversion," where individuals fear not meeting others' expectations. This is relevant to our study because, in our game, particularly under one-way communication, a lie can be seen as breaking a promise by the sender to uphold an expectation of truthfulness. This truthfulness, as per the observed $S_{onewaytruth}$ play, facilitates an efficient coordination outcome. A lie would then be a direct breach of this implicit promise to enable efficiency. Although we examine a game of private information/adverse selection rather than private actions/moral hazard, findings in this literature may help interpret our results.

In our experiment, players are only able to communicate their type through a limited language. Alternatively, some experiments allow participants to use free-form communication via chat boxes. These experiments sometimes yield different outcomes from those predicted by Nash equilibrium (as in Moreno and Wooders, 1998) or outcomes consistent with Nash equilibria that are not achieved without communication (as in Agranov and Tergiman, 2014, or Baranski and Kagel, 2015).[13] Since chat-box communication is more "realistic" than our approach, one might wonder if freer communication could alter our results. While this is ultimately an empirical issue, it is noteworthy that coordination in those games is more complex than in ours. In fact, we achieve a high level of coordination in both our treatments, even with our limited language. One might be interested in when we can generally expect less communication (or just one-way communication) to be more effective. Additionally, it will be interesting to see if the theory can capture aspects of the apparent preference for truth-telling and the individual heterogeneity in lying and deception. We defer these considerations to future research.

An important extension of this work would be to conduct the experiment with "real" stakeholders in a more naturalistic setting. Our results suggest that an artifactual field experiment is likely to be a promising avenue for further research.

[13]Guarnaschi *et al* (2000) and Goeree and Yariv (2011) study the closely related issue of deliberation in jury settings *à la* Feddersen and Pesendorfer (1996).

5 APPENDIX: INSTRUCTION MATERIALS (Supplementary materials, not intended for publication)

We report below the full set of instructions, the test and the record sheet only for the two-way treatment of the direct method. The instructions (and the corresponding test and record sheet) for the one-way and no-way treatments differ in a natural way; thus, for obvious reasons, these have been omitted here. For the strategy method, we report just the instructions for the two-way treatment. The rest of the materials are available upon request.

5.1 Instructions (Two-way)

All participants in this session have the following identical instructions. Welcome to this experiment, and thank you for participating. From now onwards please do not talk to any other participants until the experiment is finished. You will be given five minutes to read these instructions. Then we will ask you to complete a brief test to ensure that you have understood them before starting the experiment.

YOUR DECISION PROBLEM

In this experiment you are asked to make a simple choice, in each of 20 successive rounds. In each round you earn a number of points, as described below. The total number of points you accumulate over the 20 rounds determines your final money payment, at a conversion rate of 1 point = £1 (= 100 pence). At the start of the first round, the computer randomly assigns you the role of either Player 1 or Player 2. You keep this same role throughout all 20 rounds. But in each round you are randomly paired with another participant. So, if you are assigned the role of Player 1, then the Player 2 who is paired with you in each round will probably be a different participant from the Player 2 paired with you in earlier rounds. And likewise, if you are assigned the role of Player 2, then the Player 1 paired with you in each round will probably be a different participant from the Player 1 paired with you in earlier rounds. In each round, Player 1 and Player 2 each have to choose one of two alternatives, X and Y. You do so independently of each other. So at the moment you make your own choice, you do not know the choice of the other player.

YOUR EARNINGS

		Player 2's Choice	
		X	Y
Player 1's Choice	X	$1, B$	$0, 0$
	Y	$0, 0$	$A, 1$

The two players' choices together determine the points you each earn from that round, as described in the table above. The first number in each cell indicates the points earned by Player 1, and the second number indicates the points earned by Player 2. In the above table, the number A is known to player 1 only; it is either 0.65 or 0.90. The probability of the low value (0.65) is 60% while the probably of the high value (0.90) is 40%. Similarly, the number B is known to player 2 only; it is either 0.65 or 0.90. Here as well, the probability of the low value (0.65) is 60% while the probably of the high value (0.90) is 40%. At the start of each round, the values of A and B are generated randomly and independently by the computer. The interpretation of the table is as follows:

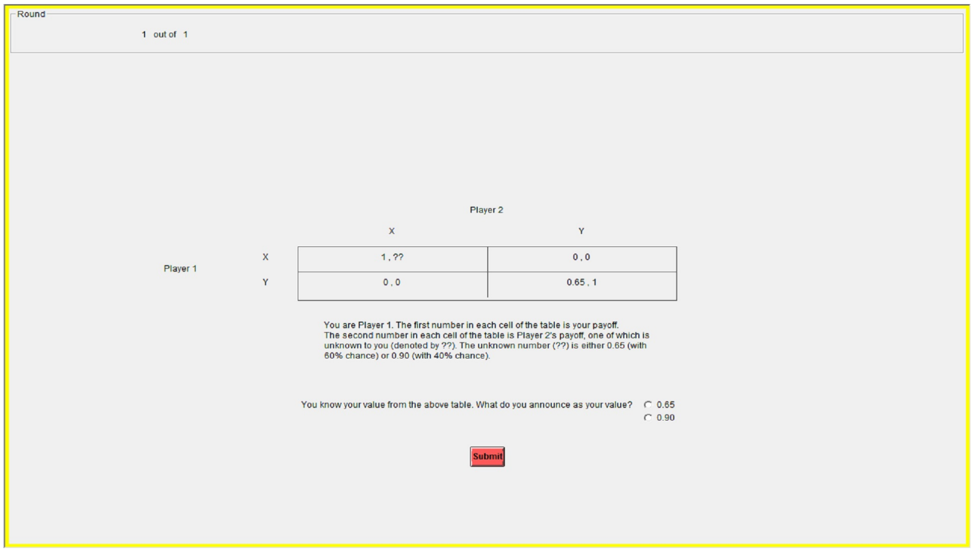
If in some round, the choices made by the two players are different (XY or YX), then both players get 0. If in some round, both players choose X, then from that round Player 1 will earn 1 point (£1) while Player 2 will earn either 0.65 (65p) or 0.90 (90p) which is known to Player 2 only. If in some round both players choose Y, then from that round Player 2 will earn 1 point (£1) while Player 1 will earn either 0.65 (65p) or 0.90 (90p) which is known to Player 1 only.

In each round, you and your counterpart are each informed of the respective values. You are informed only of the value for you, and you don't know your counterpart's value, however, as mentioned, the chances for your counterpart's value being 0.65 (65p) or 0.90 (90p) are respectively 60% and 40%, regardless of your own value.

YOUR ANNOUNCEMENT

After learning the value (and before making a choice), you and your counterpart both will be asked to make an announcement regarding your respectively values. Each of you has two alternative values to announce: 0.65 or 0.90. It is entirely up to you, in any round, whether or not to announce your true value for that round. The points that you will earn depend only on the choices made and the actual values, as described on the previous page, irrespective of the announcements.

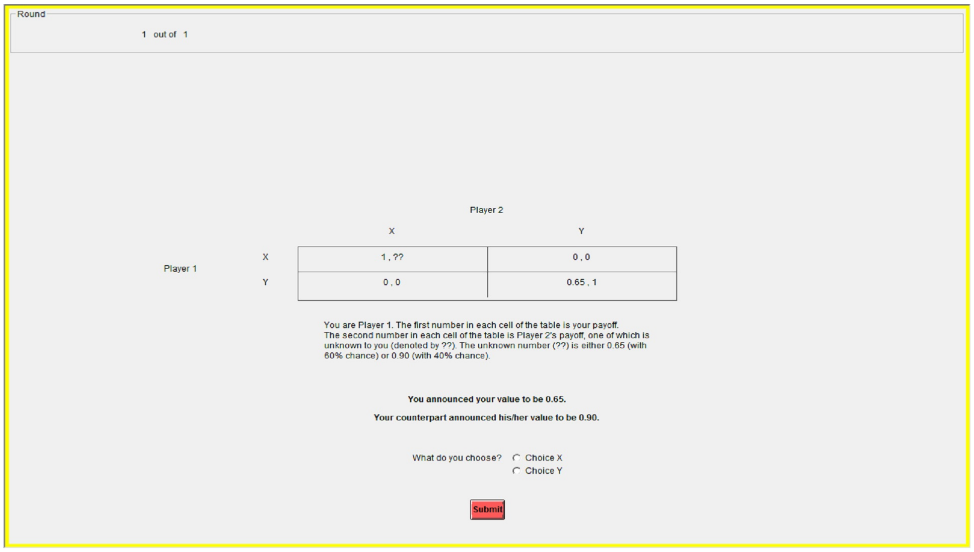
THE COMPUTER SCREEN

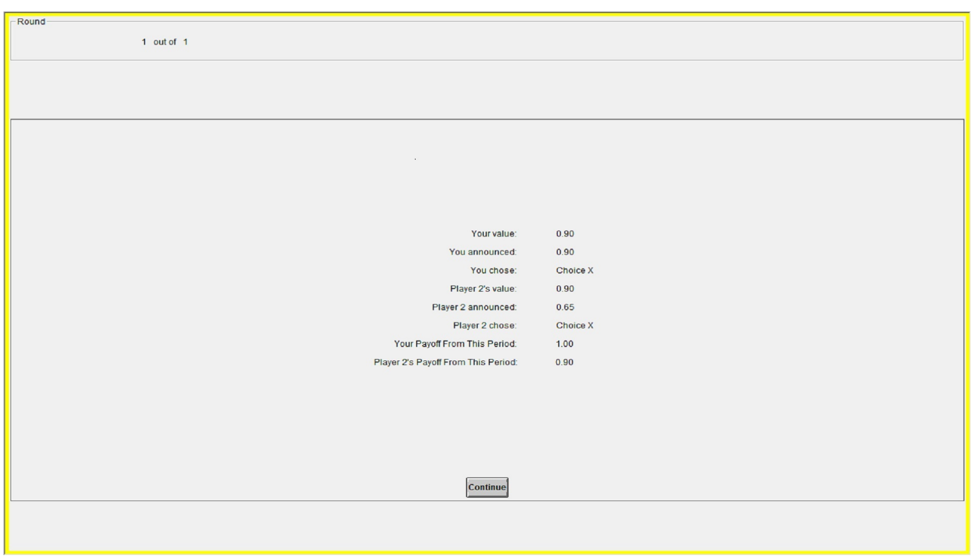


The main screen for each round looks like above. At the top of the screen there is a message which keeps count of the round, out of 20 (in this example, Round 1). In the centre of the screen is the table which appears on the first page of these instructions. Immediately below the table is a message informing you which role (Player 1 or 2) you have been assigned (in this example, Player 1). This is the same in each round. You know your value from the table (in this example, the value of Player 1 is $A = 0.65$); however, the unknown value is indicated by "??" in the table (in this example, the value of Player 2, B, is unknown to player 1 and is indicated by "??"). Having seen your value form the table, you may make your announcement of a value of 0.65 or 0.90 by selecting the appropriate button and then clicking on Submit. You may then have to wait a few moments until all participants have made their announcements, after which will appear the next screen for you (in this example, Player 1) as shown below.

In this screen, you will be informed of your and your counterpart's announced values (these may not be the true values) below the description of the table and will be asked to make a choice. To make your choice of X or Y, select the appropriate button and then click on Submit. You may then have to wait a few moments until all participants have made their choices, after which the results for you in that round will appear onscreen. The result after each round includes information of the values for the both players, choices made by each of the two players, and the points earned by each player (as below for example). On your desk there is a Record Sheet on which you can keep a note of these results, if you wish to.

After all the participants have read their results and clicked Continue, the main screen for


Round
1 out of 1
Player 2
X
Y
Player 1
X
Y
1 , ??
0 , 0
0 , 0
0.65 , 1
You are Player 1. The first number in each cell of the table is your payoff. The second number in each cell of the table is Player 2's payoff, one of which is unknown to you (denoted by ??). The unknown number (??) is either 0.65 (with 60% chance) or 0.90 (with 40% chance).
You announced your value to be 0.65.
Your counterpart announced his/her value to be 0.90.
What do you choose?
Choice X
Choice Y
Submit


Round
1 out of 1
Your value: 0.90
You announced: 0.90
You chose: Choice X
Player 2's value: 0.90
Player 2 announced: 0.65
Player 2 chose: Choice X
Your Payoff From This Period: 1.00
Player 2's Payoff From This Period: 0.90
Continue

the next round will appear again as shown earlier.

AT THE END OF THE EXPERIMENT

When all 20 rounds have been completed, you will be asked to complete a brief onscreen questionnaire, which provides useful supplementary (anonymous) information for us. Having completed the questionnaire, you will see a final screen reporting your total points accumulated over the 20 rounds and the corresponding monetary payment (in £). Please then wait for further instructions from the experimenter, who will pay you in cash before you leave. While waiting, please complete the receipt form which you will also find on your desk. We need these receipts for our own accounts. The results from this experiment will be used solely for academic research. Participants will remain completely anonymous in any publications connected with this experiment. Thank you for participating. We hope that you enjoy the experiment, and that you will be willing to participate again in our future experiments.

5.2 Test (Two-way)

After reading the instructions you will be asked to complete this brief test, to ensure you have understood them, before starting the experiment itself.

You may look again at the instructions while answering these questions.

For questions 1 – 4, write the answers in the corresponding boxes.

1. If you choose Y and your counterpart chooses X, how many points do you earn in that round?

2. Suppose your value is 0.90; if you announce 0.65 and choose X and your counterpart announces 0.65 and chooses Y, how many points do you earn in that round?

3. Suppose you are Player 1 and your value is 0.65; if you announce 0.90 and choose Y and your counterpart also chooses Y, how many points do you earn in that round?

4. If over the 20 rounds you accumulate a total of 10.65 points, what is your final cash payment (in £) for the experiment?

For questions 5 – 8, circle either True or False.

5. Your counterpart is the same person in each round. True / False

6. If the value for you is 0.65, then your counterpart's value must be 0.65. True / False

7. Suppose you are Player 1; whatever the true and announced values are, you always get more points when both of you choose the same than different. True / False

8. In any publications arising from this experiment the participants will be completely anonymous. True / False

Thank you for completing this test. Please leave this completed sheet face up on your desk.

The experimenter will come round to check that you have the correct answers. If any of your answers are incorrect then the experimenter will give you some explanatory feedback.

5.3 Record Sheet (Two-way)

Use of this sheet is optional. It is provided so that you can keep a record of the results in each round, as reported on your computer screen at the end of the round. This may be useful to you in considering your decisions in subsequent rounds.

You have been assigned the role of the Player (circle one): 1 2

In each cell in the table below, simply circle the correct value as appropriate, while the information is still on your screen at the end of that round, before clicking Continue.

Round	My Value	Announce	Choice	C'part's Value	Announce	Choice	My Point
1	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
2	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
3	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
4	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
5	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
6	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
7	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
8	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
9	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
10	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
11	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
12	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
13	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
14	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
15	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
16	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
17	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
18	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
19	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	
20	0.65 0.90	0.65 0.90	X Y	0.65 0.90	0.65 0.90	X Y	

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INSTRUCTIONS

INSTRUCTIONS NO COMMUNICATION

All participants in this session have the following identical instructions

Welcome to this experiment, and thank you for participating. From now onwards please do not talk to any other participants until the experiment is finished.

You will be given five minutes to read these instructions. Then we will ask you to complete a brief test to ensure that you have understood them, before starting the experiment itself.

Your decision problem

In this experiment you are asked to make a simple choice, in each of 20 successive rounds. In each round you earn a number of points, as described below. The total number of points you accumulate over the 20 rounds determines your final money payment, at a conversion rate of **1 point = £1 (= 100 pence)**.

At the start of the first round, the computer randomly assigns you the role of either Player 1 or Player 2. You keep this same role throughout all 20 rounds.

But in each round you are randomly paired with another participant. So, if you are assigned the role of Player 1, then the Player 2 who is paired with you in each round will probably be a different participant from the Player 2 paired with you in earlier rounds. And likewise, if you are assigned the role of Player 2, then the Player 1 paired with you in each round will probably be a different participant from the Player 1 paired with you in earlier rounds.

In each round, Player 1 and Player 2 each have to choose one of two alternatives, X and Y. You do so independently of each other and without any communication. So at the moment you make your own choice, you do not know the choice of the other player.

Your earnings

The two players' choices together determine the points you each earn from that round, as described in the following table.

		Player 2's choice: X	Player 2's choice: Y
Player 1's choice	X	1, B	0, 0
	Y	0, 0	A, 1

The first number in each cell indicates the points earned by Player 1, and the second number indicates the points earned by Player 2.

In the above table, the number A is known to player 1 only; it is either 0.65 or 0.90. The probability of the low value (0.65) is 60% while the probably of the high value (0.90) is 40%.

Similarly, the number B is known to player 2 only; it is either 0.65 or 0.90. Here as well, the probability of the low value (0.65) is 60% while the probably of the high value (0.90) is 40%.

At the start of each round, the values of A and B are generated randomly and independently by the computer.

The interpretation of the table is as follows:

If in some round, the choices made by the two players are different (XY or YX), then both players get 0.

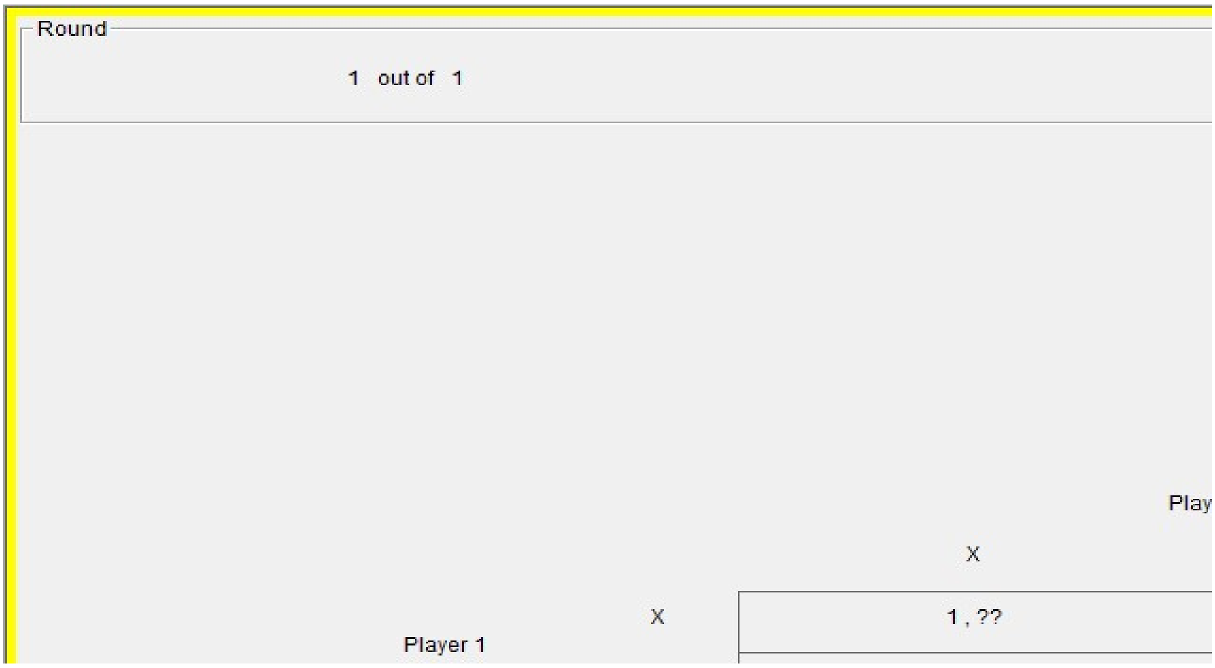
If in some round, both players choose X, then from that round Player 1 will earn 1 point (£1) while Player 2 will earn either 0.65 (65p) or 0.90 (90p) which is known to Player 2 only.

If in some round both players choose Y, then from that round Player 2 will earn 1 point (£1) while Player 1 will earn either 0.65 (65p) or 0.90 (90p) which is known to Player 1 only.

In each round, you and your counterpart are each informed of the respective values. You are informed only of the value for you, and you don't know your counterpart's value, however, as mentioned, the chances for your counterpart's value being 0.65 (65p) or 0.90 (90p) are respectively 60% and 40%, regardless of your own value.

The computer screen

The main screen for each round looks like this.

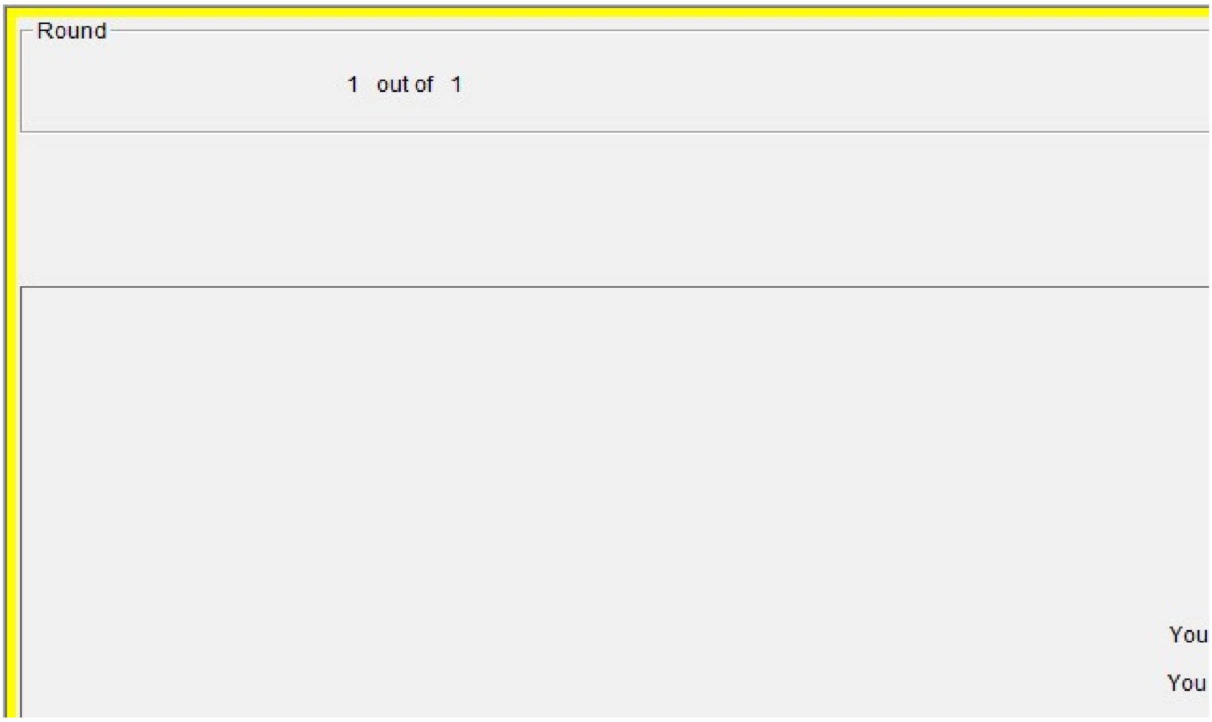


At the top of the screen there is a message which keeps count of the round, out of 20 (in this example, Round 1). In the centre of the screen is the table which appears on the first page of these instructions. Immediately below the table is a message informing you which role (Player 1 or 2) you have been assigned (in this example, Player 1). This is the same in each round.

You know your value from the table (in this example, the value of Player 1 is A = 0.65); however, the unknown value is indicated by “??” in the table (in this example, the value of Player 2, B, is unknown to player 1 and is indicated by “??”).
To make your choice of X or Y, select the appropriate button and then click on Submit. You may then have to wait a few moments until all participants have made their choices, after which the results for you in that round will appear onscreen.

The result after each round includes information of the values for the both players, choices made by each of the two players, and the points earned by each player (as below for example).

On your desk there is a Record Sheet on which you can keep a note of these results, if you wish to.



After all the participants have read their results and clicked Continue, the main screen for the next round will appear, again as shown above.

At the end of the experiment

When all 20 rounds have been completed, you will be asked to complete a brief onscreen questionnaire, which provides useful supplementary (anonymous) information for us.

Having completed the questionnaire, you will see a final screen reporting your total points accumulated over the 20 rounds and the corresponding monetary payment (in £).

Please then wait for further instructions from the experimenter, who will pay you in cash before you leave. While waiting, please complete the receipt form which you will also find on your desk. We need these receipts for our own accounts.

The results from this experiment will be used solely for academic research. Participants will remain completely anonymous in any publications connected with this experiment.

Thank you for participating. We hope that you enjoy the experiment, and that you will be willing to participate again in our future experiments.

INSTRUCTIONS ONE SIDED COMMUNICATION

All participants in this session have the following identical instructions

Welcome to this experiment, and thank you for participating. From now onwards please do not talk to any other participants until the experiment is finished.

You will be given five minutes to read these instructions. Then we will ask you to complete a brief test to ensure that you have understood them, before starting the experiment itself.

Your decision problem

In this experiment you are asked to make a simple choice, in each of 20 successive rounds. In each round you earn a number of points, as described below. The total number of points you accumulate over the 20 rounds determines your final money payment, at a conversion rate of **1 point = £1 (= 100 pence)**.

At the start of the first round, the computer randomly assigns you the role of either Player 1 or Player 2. You keep this same role throughout all 20 rounds.

But in each round you are randomly paired with another participant. So, if you are assigned the role of Player 1, then the Player 2 who is paired with you in each round will probably be a different participant from the Player 2 paired with you in earlier rounds. And likewise, if you are assigned the role of Player 2, then the Player 1 paired with you in each round will probably be a different participant from the Player 1 paired with you in earlier rounds.

In each round, Player 1 and Player 2 each have to choose one of two alternatives, X and Y. You do so independently of each other. So at the moment you make your own choice, you do not know the choice of the other player.

Your earnings

The two players' choices together determine the points you each earn from that round, as described in the following table.

		Player 2's choice	
		X	Y
Player 1's choice	X	1, B	0, 0
	Y	0, 0	A, 1

The first number in each cell indicates the points earned by Player 1, and the second number indicates the points earned by Player 2.

In the above table, the number A is known to player 1 only; it is either 0.65 or 0.90. The probability of the low value (0.65) is 60% while the probably of the high value (0.90) is 40%. Similarly, the number B is known to player 2 only; it is either 0.65 or 0.90. Here as well, the probability of the low value (0.65) is 60% while the probably of the high value (0.90) is 40%.

At the start of each round, the values of A and B are generated randomly and independently by the computer.

The interpretation of the table is as follows:

If in some round, the choices made by the two players are different (XY or YX), then both players get 0.

If in some round, both players choose X, then from that round Player 1 will earn 1 point (£1) while Player 2 will earn either 0.65 (65p) or 0.90 (90p) which is known to Player 2 only.

If in some round both players choose Y, then from that round Player 2 will earn 1 point (£1) while Player 1 will earn either 0.65 (65p) or 0.90 (90p) which is known to Player 1 only.

In each round, you and your counterpart are each informed of the respective values. You are informed only of the value for you, and you don't know your counterpart's value, however, as mentioned, the chances for your counterpart's value being 0.65 (65p) or 0.90 (90p) are respectively 60% and 40%, regardless of your own value.

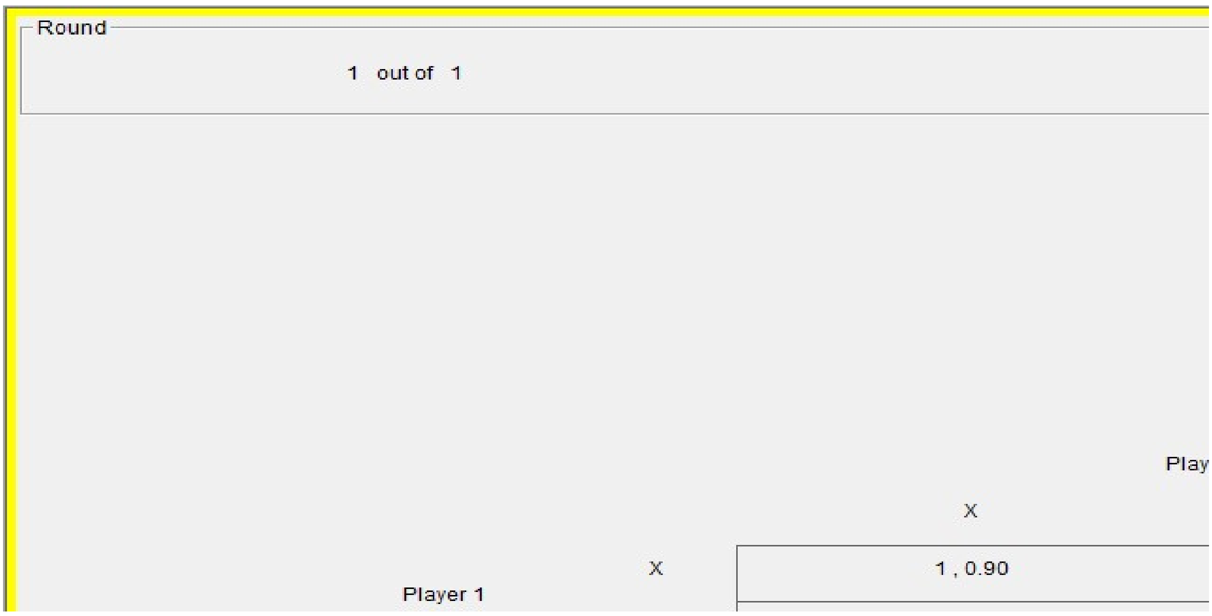
The announcement

After learning the value (and before making a choice), either you or your counterpart will be randomly selected (with 50-50 chance) and will be asked to make an announcement regarding the respectively value. The announcement can be of two alternative values: 0.65 or 0.90.

It is entirely up to the person selected, in any round, whether or not to announce the true value for that round. The points that you will earn depend only on the choices made and the actual values, as described on the previous page, irrespective of the announcements.

The computer screen

The main screen for each round looks like this for the player who has been selected to make an announcement.



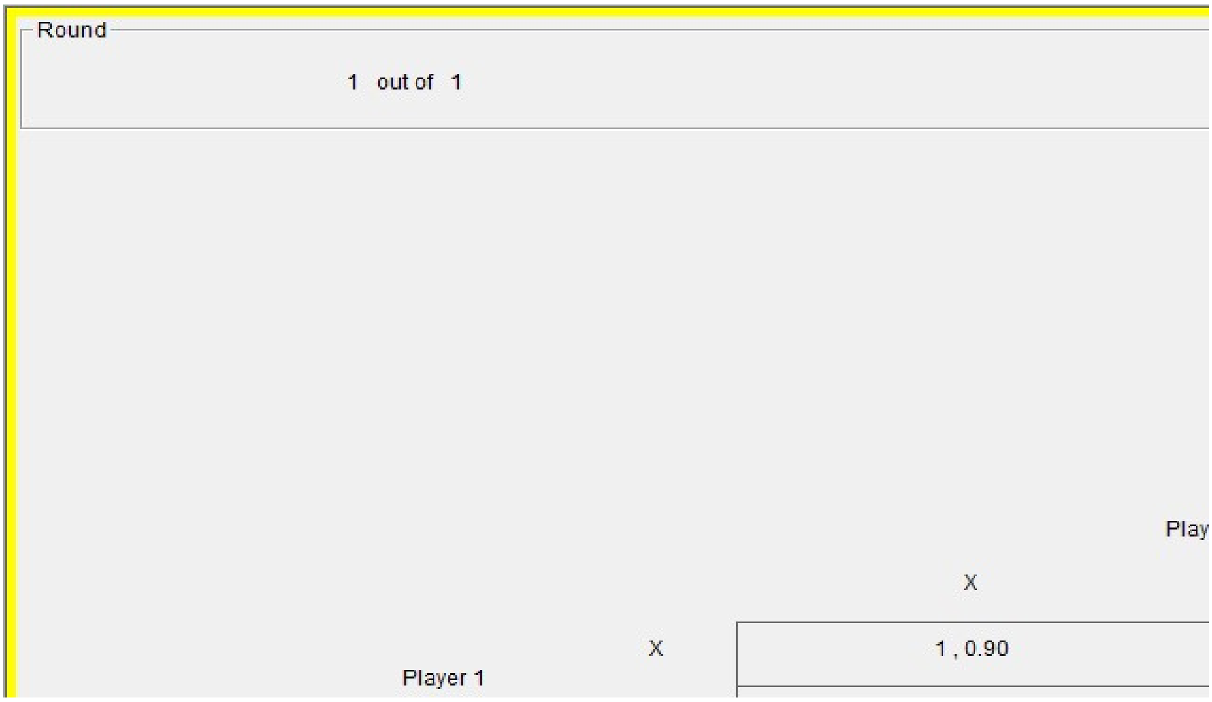
At the top of the screen there is a message which keeps count of the round, out of 20 (in this example, Round 1). In the centre of the screen is the table which appears on the first page of these instructions. Immediately below the table is a message informing you which role (Player 1 or 2) you have been assigned (in this example, Player 2). This is the same in each round.

You know your value from the table (in this example, the value of Player 1 is A = 0.65); however, the unknown value is indicated by "??" in the table (in this example, the value of Player 2, B, is unknown to player 1 and is indicated by "??").

In this example, for this particular round Player 2 has been selected to make an announcement. Having seen your value form the table (in this example 0.90), you may make your announcement of a value of 0.65 or 0.90 by selecting the appropriate button and then clicking on Submit.

If in one round, you have not been selected to announce the main screen for that round for you will instead indicate that "your counterpart has been randomly selected to announce his/her value", in which case you must click the Continue button.

You may then have to wait a few moments until all participants have made their announcements, after which will appear the next screen for you (in this example, Player 2 as the player who announced) as shown below (otherwise it will show the counterpart's announcement).

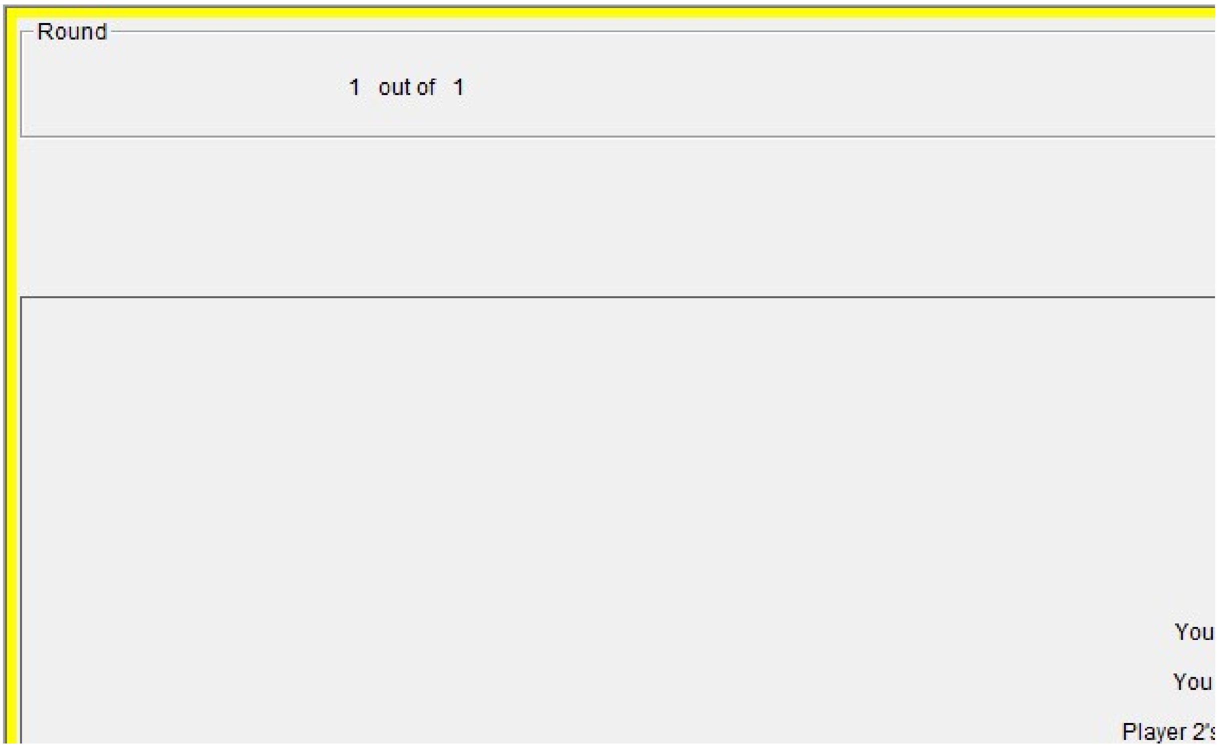


In this screen, you will be informed of your and your counterpart's announced values (these may not be the true values) below the description of the table and will be asked to make a choice. To make your choice of X or Y, select the appropriate button and then click on Submit.

You may then have to wait a few moments until all participants have made their choices, after which the results for you in that round will appear onscreen.

The result after each round includes information of the values for the both players, choices made by each of the two players, and the points earned by each player (as below for example).

On your desk there is a Record Sheet on which you can keep a note of these results, if you wish to.



After all the participants have read their results and clicked Continue, the main screen for the next round will appear, again as shown in Page 2.

At the end of the experiment

When all 20 rounds have been completed, you will be asked to complete a brief onscreen questionnaire, which provides useful supplementary (anonymous) information for us.

Having completed the questionnaire, you will see a final screen reporting your total points accumulated over the 20 rounds and the corresponding monetary payment (in £).

Please then wait for further instructions from the experimenter, who will pay you in cash before you leave. While waiting, please complete the receipt form which you will also find on your desk. We need these receipts for our own accounts.

The results from this experiment will be used solely for academic research. Participants will remain completely anonymous in any publications connected with this experiment.

Thank you for participating. We hope that you enjoy the experiment, and that you will be willing to participate again in our future experiments.

INSTRUCTIONS TWO-SIDED COMMUNICATION

All participants in this session have the following identical instructions

Welcome to this experiment, and thank you for participating. From now onwards please do not talk to any other participants until the experiment is finished.

You will be given five minutes to read these instructions. Then we will ask you to complete a brief test to ensure that you have understood them, before starting the experiment itself.

Your decision problem

In this experiment you are asked to make a simple choice, in each of 20 successive rounds. In each round you earn a number of points, as described below. The total number of points you accumulate over the 20 rounds determines your final money payment, at a conversion rate of **1 point = £1 (= 100 pence)**.

At the start of the first round, the computer randomly assigns you the role of either Player 1 or Player 2. You keep this same role throughout all 20 rounds.

But in each round you are randomly paired with another participant. So, if you are assigned the role of Player 1, then the Player 2 who is paired with you in each round will probably be a different participant from the Player 2 paired with you in earlier rounds. And likewise, if you are assigned the role of Player 2, then the Player 1 paired with you in each round will probably be a different participant from the Player 1 paired with you in earlier rounds.

In each round, Player 1 and Player 2 each have to choose one of two alternatives, X and Y. You do so independently of each other. So at the moment you make your own choice, you do not know the choice of the other player.

Your earnings

The two players' choices together determine the points you each earn from that round, as described in the following table.

		Player 2's choice: X	Player 2's choice: Y
Player 1's choice	X	1, B	0, 0
	Y	0, 0	A, 1

The first number in each cell indicates the points earned by Player 1, and the second number indicates the points earned by Player 2.

In the above table, the number A is known to player 1 only; it is either 0.65 or 0.90. The probability of the low value (0.65) is 60% while the probably of the high value (0.90) is 40%. Similarly, the number B is known to player 2 only; it is either 0.65 or 0.90. Here as well, the probability of the low value (0.65) is 60% while the probably of the high value (0.90) is 40%.

At the start of each round, the values of A and B are generated randomly and independently by the computer.

The interpretation of the table is as follows:

If in some round, the choices made by the two players are different (XY or YX), then both players get 0.

If in some round, both players choose X, then from that round Player 1 will earn 1 point (£1) while Player 2 will earn either 0.65 (65p) or 0.90 (90p) which is known to Player 2 only.

If in some round both players choose Y, then from that round Player 2 will earn 1 point (£1) while Player 1 will earn either 0.65 (65p) or 0.90 (90p) which is known to Player 1 only.

In each round, you and your counterpart are each informed of the respective values. You are informed only of the value for you, and you don't know your counterpart's value, however, as mentioned, the chances for your counterpart's value being 0.65 (65p) or 0.90 (90p) are respectively 60% and 40%, regardless of your own value.

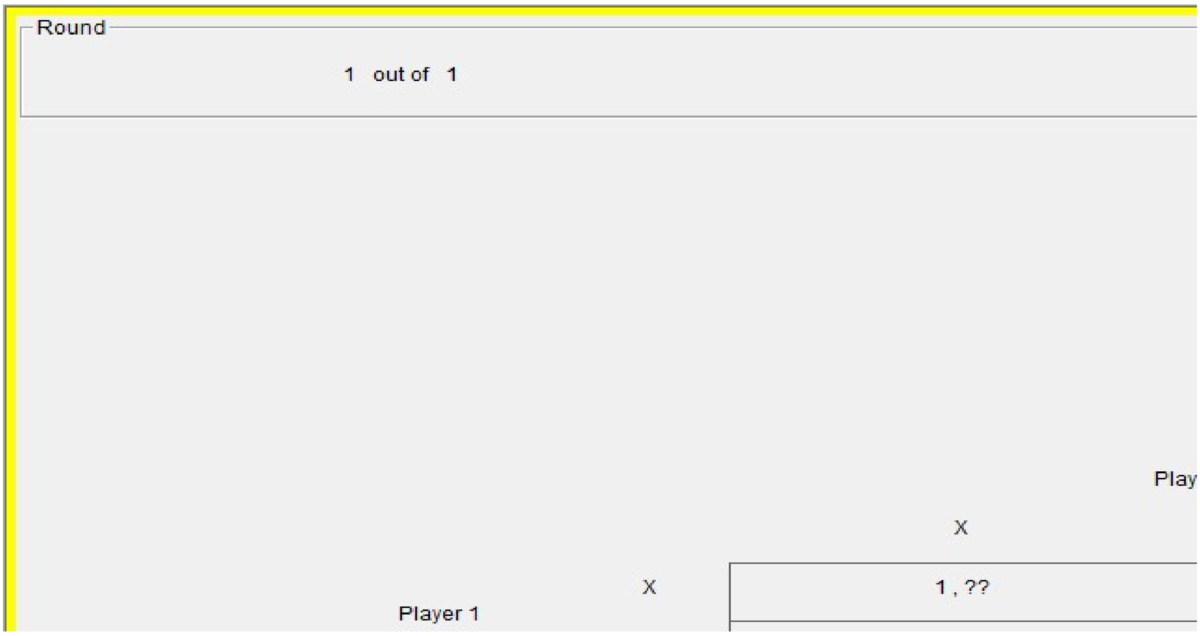
Your announcement

After learning the value (and before making a choice), you and your counterpart both will be asked to make an announcement regarding your respectively values. Each of you has two alternative values to announce: 0.65 or 0.90.

It is entirely up to you, in any round, whether or not to announce your true value for that round. The points that you will earn depend only on the choices made and the actual values, as described on the previous page, irrespective of the announcements.

The computer screen

The main screen for each round looks like this.

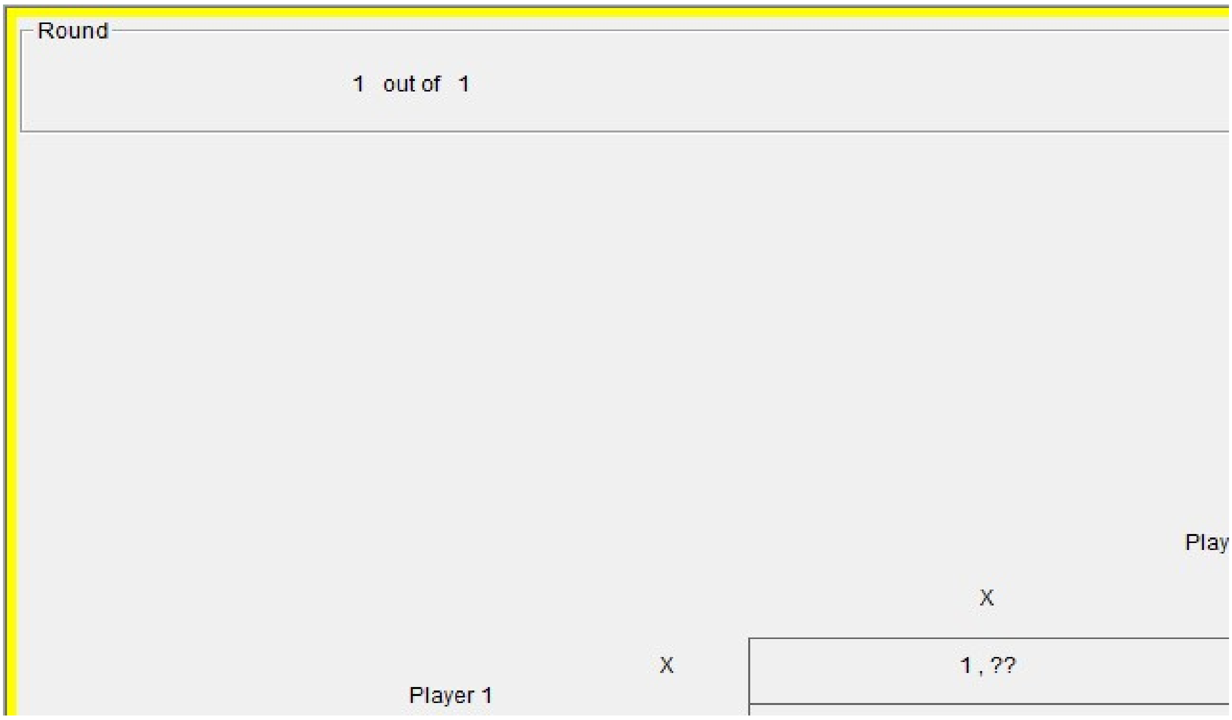


At the top of the screen there is a message which keeps count of the round, out of 20 (in this example, Round 1). In the centre of the screen is the table which appears on the first page of these instructions. Immediately below the table is a message informing you which role (Player 1 or 2) you have been assigned (in this example, Player 1). This is the same in each round.

You know your value from the table (in this example, the value of Player 1 is A = 0.65); however, the unknown value is indicated by "??" in the table (in this example, the value of Player 2, B, is unknown to player 1 and is indicated by "??").

Having seen your value form the table, you may make your announcement of a value of 0.65 or 0.90 by selecting the appropriate button and then clicking on Submit.

You may then have to wait a few moments until all participants have made their announcements, after which will appear the next screen for you (in this example, Player 1) as shown below.

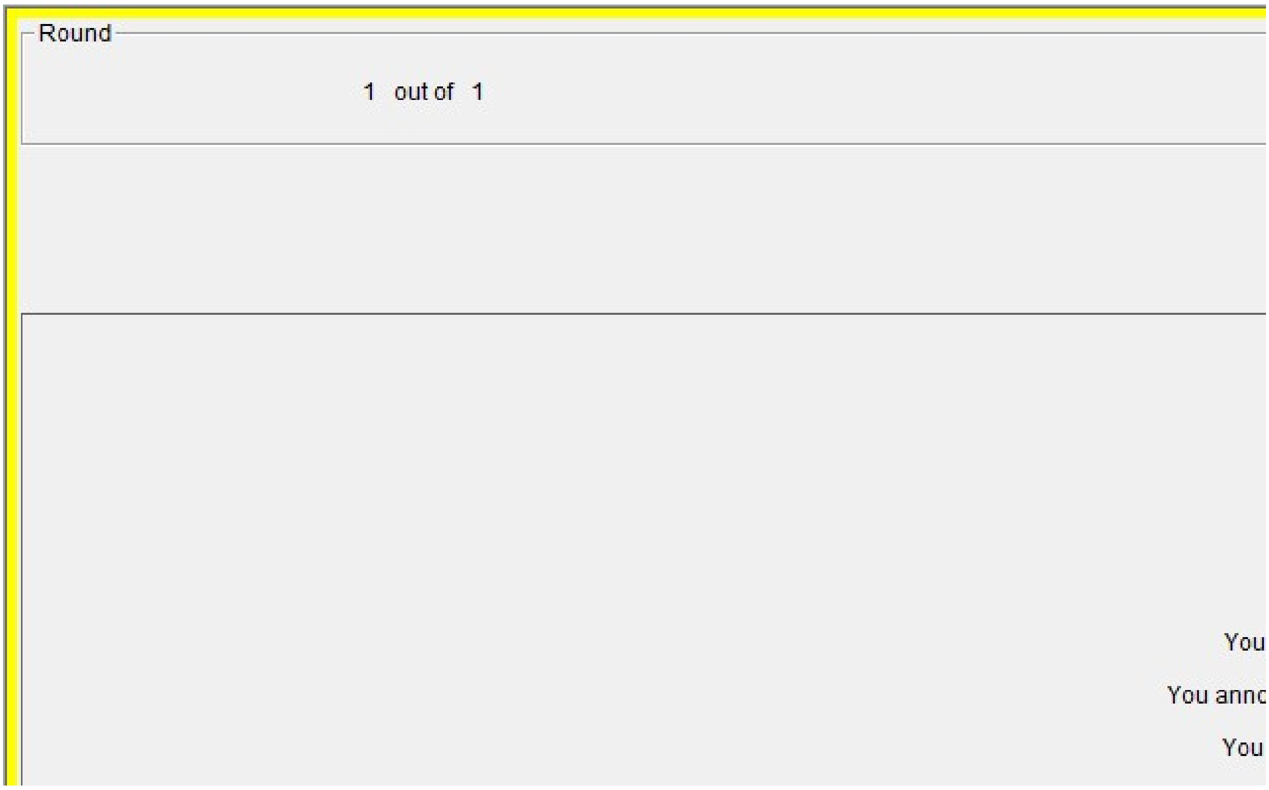


In this screen, you will be informed of your and your counterpart's announced values (these may not be the true values) below the description of the table and will be asked to make a choice. To make your choice of X or Y, select the appropriate button and then click on Submit.

You may then have to wait a few moments until all participants have made their choices, after which the results for you in that round will appear onscreen.

The result after each round includes information of the values for the both players, choices made by each of the two players, and the points earned by each player (as below for example).

On your desk there is a Record Sheet on which you can keep a note of these results, if you wish to.



After all the participants have read their results and clicked Continue, the main screen for the next round will appear, again as shown in Page 2.

At the end of the experiment

When all 20 rounds have been completed, you will be asked to complete a brief onscreen questionnaire, which provides useful supplementary (anonymous) information for us.

Having completed the questionnaire, you will see a final screen reporting your total points accumulated over the 20 rounds and the corresponding monetary payment (in £).

Please then wait for further instructions from the experimenter, who will pay you in cash before you leave. While waiting, please complete the receipt form which you will also find on your desk. We need these receipts for our own accounts.

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