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Authors
Serra-Garcia, Marta
van Damme, Eric
Potters, Jan

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LYING ABOUT WHAT YOU *KNOW* OR ABOUT WHAT YOU *DO*?

Marta Serra-Garcia
University of Munich

Eric van Damme
CentER and TILEC, Tilburg University

Jan Potters
CentER, Tiber, TILEC and Netspar,
Tilburg University

Abstract
We compare communication about private information to communication about actions in a one-shot 2-person public good game with private information. The informed player, who knows the exact return from contributing and whose contribution is unobserved, can send a message about the return or her contribution. Theoretically, messages can elicit the uninformed player's contribution, and allow the informed player to free-ride. The exact language used is not expected to matter. Experimentally, however, we find that free-riding depends on the language: the informed player free-rides less—and thereby lies less frequently—when she talks about her contribution than when she talks about the return. Further experimental evidence indicates that it is the promise component in messages about the contribution that leads to less free-riding and less lying. (JEL: E21, E12)

1. Introduction

We study the effect of cheap talk messages in a public good game with asymmetric information. We compare, theoretically and experimentally, a setting in which the informed player can send a message about her private information, to one in which she can send a message about her contribution. Our main question is whether the message patterns (rates of lying) and outcomes (contribution levels) are affected by whether the informed player can talk about what she *knows* or about what she *does*, i.e. on the

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E-mail: marta.serragarcia@lmu.de (Serra-Garcia); eric.vandamme@uvt.nl (van Damme);
j.j.m.potters@uvt.nl (Potters)

'language' available. A variety of recent experimental studies show that individuals lie less often than material incentives would predict. Some show this for communication about private information, others for communication about actions.[1] To the best of our knowledge, our paper is the first to compare the two types of communication in a unified framework.

Our analysis proceeds in the context of a two-player one-shot public good game. The game is symmetric with respect to the players' contributions. The return to a contribution can take three different values, which are equally likely. If the return is low, it is individually rational and (Pareto) efficient not to contribute. If it is intermediate, the game is a prisoners' dilemma: it is efficient to contribute, but each player has an incentive to free ride. Finally, if the return is high, contributing is both individually rational and efficient. The exact state of nature, however, is only known to one of the players. The parameters are set such that, in case no signaling is possible, the uninformed player will not contribute and the informed player will only contribute if the return is high. Thus, contributions are inefficiently low. On the other hand, if the informed player can credibly signal that the return is either intermediate or high, and the uninformed player considers both possibilities to be equally likely, he has an incentive to contribute.

We study the effect of cheap talk on contributions, focusing on two languages. The first language allows the informed player to talk about the return to a contribution. She can say 'the return is low', 'the return is intermediate', or 'the return is high'. The second language allows her to talk about her contribution decision. The informed player can say 'I do not contribute' or 'I contribute'. In both of these cases, talk is cheap, that is, the messages do not directly influence the payoffs.

To evaluate the effects of communication, we consider two benchmark games. The first is a game with simultaneous moves in which no signaling is possible. In this case, the informed player only contributes when the return is high and the uninformed player never contributes, hence, contributions are inefficiently low. The second benchmark is a game with sequential moves in which the informed player's contribution is revealed to the uninformed player, before he makes his contribution decision. The informed player now has an incentive to contribute if (and only if) the return is high or intermediate. Her contribution then signals to the uninformed player that he should contribute as well. Since both players contribute unless the returns are low, the game with sequential moves produces a fully efficient equilibrium.

The comparison of simultaneous versus sequential moves has been widely studied. Theoretically, Hermalin (1998) and Vesterlund (2003), show that, if informed players contribute first to a team project or charity, they can 'lead by example': their contribution can elicit the contribution of uninformed players and enhance efficiency. Experimentally, Potters et al. (2007) find support for these results, in a setting where no

1. See, for example, Cai and Wang (2006), Gneezy (2005), Erat and Gneezy (2009), Lundquist et al. (2009), and Radner and Schotter (1989) for communication about private information, and Charness and Dufwenberg (2006), Ellingsen and Johannesson (2004), Vanberg (2008) for communication (promises) about actions.

verbal communication was possible.[2] However, sequential moves are not the only way to increase efficiency. In a simultaneous move game allowing the informed player to talk about the return to a contribution, or about the size of the own contribution could positively affect efficiency. In this paper we examine this possibility, considering as well whether the language available matters.[3]

From a standard theoretical perspective, the exact language is irrelevant: for any language that contains at least two different messages, there are two equilibrium outcomes. In the first, babbling, equilibrium, words are ignored and contribution levels are as in the simultaneous moves benchmark. In the second, influential, equilibrium, the informed player sends the same message (say G) when the return is intermediate and when it is high, and a different message (say B) when the return is low. The uninformed player contributes only after having heard G. Hence, the message G (in words) can be as influential as observing the informed player's contribution.

We extend the standard analysis following recent models that assume players have small but positive lying costs (e.g. Kartik et al., 2007, Kartik, 2009).[4] We show that with this assumption only the influential equilibrium survives. Moreover, the presence of lying costs pins down the messages that will be sent in equilibrium. The informed player will be truthful when the return to the public good is low and when it is high. She will use messages 'the return is low' and 'I do not contribute' in the former case, and 'the return is high' and 'I contribute' in the latter. Further, if lying costs are small, she will lie when the return is intermediate, under both languages. She will exaggerate the return, by saying it is high, when talk is about returns, and she will announce 'I contribute', but not do so, when talk is about actions.

Based on this analysis, our prediction is that the available language does not matter. Independent of the message set, (1) the informed player will contribute if and only if the return is high, (2) the informed player will lie in case the return is intermediate, and tell the truth when the return is low or high, and (3) the informed player is influenced by the message sent and will contribute if and only if he hears 'the return is high' or 'I contribute'. We test these hypotheses experimentally.

Our experiment reveals that, as predicted, the informed player almost never contributes when the return is low and almost always contributes when the return is high. This is independent of the available messages. Yet, in contrast to what was predicted, in the intermediate return it does matter what language is available. While free riding by the informed player is very frequent (86%) when she talks about

2. Several studies have investigated the effect of observing another player's contribution before deciding one's own (sequential moves) in complete information settings (e.g. Güth et al., 2007, Moxnes and van der Heijden, 2003). We consider a situation in which there is private information.

3. In a related paper, Serra-Garcia et al. (2011), we focus on the sequential moves game and ask a different question, does communication in the sequential moves case decrease efficiency? Our results show that this is not the case, though individuals reveal a preference to use vague messages, when these are available.

4. Demichelis and Weibull (2008) follow a similar approach, assuming that players have a lexicographic preference, after payoffs, for choosing an action which is in line with the meaning of the message they send.

her information, it falls significantly when she talks about her contribution (67%). Relatedly, the rate of lying differs across languages when the return is intermediate. If the informed player talks about the return, she is truthful less than a quarter of the times (20.6%). If she talks about her contribution, this rate almost doubles (41.1%). As hypothesized, when the return is low and high, the informed player is truthful in most cases, under both languages. Finally, the uninformed player is affected by the cheap talk. When he receives the message 'the return is high' or the message 'I contribute' he contributes in the majority of the cases (61% and 53%, respectively). These contribution rates are higher than in response to any of the other messages. They are also higher than in the simultaneous move game without messages (39%), but lower than after a contribution by the informed player in the game with sequential moves (88%).

Why does the informed player contribute more and lie less when she talks about her actions than in case she talks about her information? We suggest two explanations, which both relax one of assumptions of the theoretical model. One explanation is that lying costs are not small, as we assumed, but 'substantial'. The informed player may then want to avoid lying in the intermediate return if the foregone payoffs are not too high. The cheapest way to prevent lying when talking about actions is to say 'I contribute' and actually do so, rather than free ride. When talking about the return, if the informed player reveals the intermediate return truthfully, the uninformed player no longer contributes, which decreases the informed player's monetary payoffs much more than foregoing the possibility to free ride. The second explanation elaborates on the idea that there may be different types of lies, and that some lies may be perceived as being more costly than others. In this respect, we note that the message 'I contribute' may be perceived as similar to a promise, as it refers to an action of the speaker. In contrast, the message 'the return is high' does not resemble a promise. The norm that promises should be kept may be stronger than the norm that one should not lie, and, therefore, players may be less likely to not contribute when they have announced a contribution. In social dilemmas and trust games, with symmetric information, promises are often made and kept (Balliet, 2010, Charness and Dufwenberg, 2006, Ellingsen and Johannesson, 2004, Vanberg, 2008). Our experiment potentially reveals a similar effect in a game of private information.

We conducted an additional treatment to distinguish between these two explanations. In this treatment, informed players could only send a message after having chosen their contribution, which was simply a report of their chosen action: 'I have contributed' or 'I have not contributed'. While nothing changes in terms of the payoff consequences of messages, the resemblance to a promise in the language about actions is eliminated. The results reveal that, when the return is intermediate, the informed player now free-rides more frequently (83% of the time), and does so at a similar rate as when talking about the return. This supports the second explanation discussed above. It is not that lying can be avoided more cheaply when talking about actions (as the first explanation posited), but rather that 'I contribute' is a message which seems psychologically more costly to violate than it is to falsely claim that 'the return is high' or 'I have contributed'. The fact that the first message sounds more like a promise than the latter two can explain this difference.

Our paper contributes to the existing literature on cheap talk in several ways. First, whereas previous studies have focused either on talk about information or on talk about actions, we compare these types of communication in a unified framework. We explore how lying costs may shape the pattern of messages and actions, and how this may depend on the available language. Second, to examine the impact of cheap talk we compare it to two benchmarks. One in which no signaling is possible (the simultaneous moves game), and one in which costly signaling is possible (the sequential moves game). Here we contribute to the studies that compare 'words versus actions' in games of complete information (Bracht and Feltovich, 2009, Duffy and Feltovich, 2002 and 2006, and Wilson and Sell, 1997)[5], while we compare words to sequential moves, in a game with incomplete information.

The structure of the paper is as follows. In Section 2, we develop the theoretical framework. We describe the experimental design in Section 3 and move to the results in Section 4. Section 5 discusses the additional treatment that we ran upon analyzing the first set of results. Section 6 concludes. All proofs are presented in Online Appendix A.

2. Theoretical Framework

We study a one-shot public good game with two players, I and U. Each player i decides whether or not to contribute to the public good, where $x_i = 1$ indicates a contribution and $x_i = 0$ none. Whenever convenient, we will also denote the action of I by x and the action of U by y. The return to a contribution, also called the state, s, can take three different values ($s \in S = \{a, b, c\}$) with equal probability. Player I is informed about the state, while player U just knows that all three states are equally likely. The payoff function of the game is given by

$$u_i = 1 - x_i + s(x_i + v x_j), \quad j \neq i; i, j \in \{I, U\}, \tag{2.1}$$

where $v > 0$ represents the externality. Throughout the paper, we assume $0 = a < b < 1 < c < 2$, $b + c > 2$, and $b > 1/(1 + v)$.[6] These parameter restrictions imply: (i) player I has a strictly dominant action in each state, with a contribution being optimal only in state c; (ii) against the prior, player U's best response is not to contribute; (iii) if U believes that the state is not a and attaches 50% probability to each of b and c, his best response is to contribute; (iv) if $s = a$, it is individually optimal and Pareto efficient not to contribute; (v) if $s = c$, contributing is individually optimal and Pareto

5. Also Brandts and Cooper (2007) compare words to financial incentives used by a 'manager' in a weak-link coordination game. Çelen et al. (2010) compare advice to observation of other's actions in a social learning environment.

6. The theoretical results generalize to $a \leq 0$; as we did the experiment with $a = 0$, we restrict our attention to this case, to simplify the exposition of the theory.

efficient; and (vi) if $s = b$, the game is a Prisoners' Dilemma, hence, it is socially optimal to contribute, but individually rational not to do so.

2.1. Two Benchmark Games

Let us first consider the case where player I cannot communicate information to player U. Formally, consider the game G_{sim} where the players simultaneously choose their contributions. A (pure) strategy[7] of player I is denoted as $\sigma = (x_a, x_b, x_c)$, where x_s denotes the contribution in state s; a strategy τ of player U specifies this player's contribution, $\tau \in \{0, 1\}$. It immediately follows from our assumptions that, in the unique Nash Equilibrium (NE) of the game, only the informed player contributes, and then only if $s = c$.

PROPOSITION 1. *The simultaneous move game has a unique Nash Equilibrium, given by* $(\sigma^*, \tau^*) = \{(0, 0, 1); 0\}$.

Clearly, the NE outcome is inefficient: the players can improve in the states b and c. Allowing player I to communicate about the state can improve upon this outcome. One way in which player I can signal the state is through 'leading by example', that is, by making an (observable) contribution first. Formally, this corresponds to the sequential move game G_{seq}: I chooses her contribution x first; the uninformed player U observes x and then chooses his contribution y. A strategy σ of the informed player is defined as above; a strategy τ of player U now is denoted as $\tau = (\tau_0, \tau_1)$, where τ_z denotes the contribution given $x = z$. The next Proposition states that the sequential move game has a unique NE. In this equilibrium, both players contribute in the states b and c, hence, the equilibrium outcome is fully efficient. Efficiency is achieved since a contribution by the informed player is influential: the uninformed player contributes if and only if the informed player does so.

PROPOSITION 2. *The sequential move game has a unique Nash Equilibrium, given by* $(\sigma^*, \tau^*) = \{(0, 1, 1); (0, 1)\}$.

2.2. Communication

Our interest in this paper is in the case where cheap talk communication is added to the simultaneous move game. We introduce such communication by allowing the informed player I to send a message m, from a given (finite, non-singleton) set of messages M, to the uninformed player U. Formally, after having seen s, player I now chooses m_s and x_s, with m_s (and only m_s) being observed by U before this player decides about

7. With the exception of game $G(M)$, all games considered in this paper only have (reasonable) equilibria that are in pure strategies. Accordingly, to keep the exposition simple, we provide notation only for pure strategies.

his contribution y. The payoff function remains as in (2.1), hence, communication is costless. We write $G(M)$ for the resulting game.

We denote a strategy of player I in $G(M)$ as $\sigma = (\sigma_a, \sigma_b, \sigma_c)$ where $\sigma_s = (m_s, x_s)$; $m_s \in M$ is the message of type s and x_s is its contribution. Similarly τ specifies, for each $m \in M$, the contribution τ_m of player U after the message m.

In any equilibrium of $G(M)$, the contribution of player I will be as in the unique equilibrium of G_{sim}, hence, cheap talk communication cannot produce fully efficient outcomes. However, communication may influence the behavior of player U and can thus increase efficiency. There are two sets of pure strategy equilibria.[8] In the equilibria of the first type, communication is viewed as "pure babbling" and is, therefore, neglected, so that player U never contributes, no matter what message is sent. Hence, the outcome is just as in G_{sim}. In the equilibria of the second type, the informed player's messages are influential, i.e. they induce the uninformed player to contribute when the state is b or c, but not when the state is a. In these equilibria, player U's contributions are as in game G_{seq}, while player I's contributions are as in game G_{sim}, hence, player I free rides when $s = b$. We call the latter 'influential' equilibria. Note that, since messages are costless, standard equilibrium analysis leaves undetermined which messages will be used to elicit a contribution; there is, therefore, quite some (payoff irrelevant) multiplicity of equilibria.

Proposition 3. *There are two sets of pure strategy equilibria in the game $G(M)$ with cheap talk communication:*

(i) babbling equilibria with $x(\sigma) = (0, 0, 1)$ and $\tau_m = 0$ for all $m \in M$;
(ii) influential equilibria with $x(\sigma) = (0, 0, 1)$,$m(\sigma) = (m_a, m_{bc}, m_{bc})$ with $=m_a \neq m_{bc}$,$\tau_{m_a} = 0$ and $\tau_{m_{bc}} = 1$.

Following Farrell (1985, 1993), we can eliminate the babbling equilibria by assuming that the two players share a rich, common language, in which messages have a natural, focal meaning. In this setting, although messages do not need to be believed, they will be understood. Specifically, assume that the set of messages M is rich enough so that the message 'the state is either b or c' is available. According to Farrell, this message upsets any babbling equilibrium: if it is spoken, it will not only be understood, but it will also be believed, so that player U will respond to it by a contribution, thereby giving player I the incentive to use this message precisely when the state is b or c. Formally, the set $\{b, c\}$ is said to be self-signaling with respect to the equilibria of type 1. Farrell's concept of neologism-proofness insists that an equilibrium cannot be upset by any self-signaling set.[9] Babbling equilibria, hence, are not neologism-proof.

8. There are also mixed strategy equilibria, even with different payoffs. For example, type a may randomize between the messages m and m' in such a way that, when both type b and type c choose m', player U is indifferent between contributing or not. As such equilibria are eliminated by the refinements discussed in Propositions 4 and 5, we do not discuss them here.

9. Formal definitions of these concepts are included in the proof of Proposition 4 (see Online Appendix A).

In contrast, influential equilibria are trivially neologism-proof as in these player I gets his best possible payoff for every possible state s of the world. Consequently, we have:

PROPOSITION 4. *Only the influential equilibria of the game $G(M)$ with communication are neologism-proof.*

Note that, while neologism-proofness determines the players' contributions, it leaves undetermined the actual messages that will be used. There are thus many (payoff-equivalent) neologism-proof equilibria. Since certain messages are more natural than others, this may be viewed as a drawback of the concept. For example, in the context described above, one would expect the types b and c to indeed use the message 'the state is b or c', but neologism-proofness does not force this. A second drawback is that the concept assumes that the players have a rich language at their disposal. This may not always be the case and, intuitively also does not seem necessary to rule out the babbling equilibria; we believe that these are also unlikely to emerge when only a small set of words is available. The experiment that we will discuss in the remainder of this paper indeed illustrates this. For both of these reasons, we do not rely on neologism-proofness to justify the restriction to influential equilibria. Below, we provide a formal argument that (i) like Farrell (1985, 1993) assumes that the messages in M have a natural, focal meaning, (ii) works also for small message sets, (iii) justifies the restriction to influential equilibria, and (iv) not only determines the players' contributions, but also fully specifies the messages that will be used in equilibrium. While we develop the formal argument only for the two specific message sets that we will consider in the experiment, the proof of Proposition 5 makes clear that it generalizes to other message sets.

From now on, let us focus on the two specific message sets that will also be used in the experiment. In the first case, player I is allowed to talk about the state of nature; in the second case, she may communicate about her contribution. In each case, we force the informed player to communicate precisely; she is allowed to mention only one state in the first case, and has to say either 'I contribute' or 'I do not contribute' in the second. Formally, the first case corresponds to $M = M(S) = \{a, b, c\}$, while the second case corresponds to $M = M(X) = \{0, 1\}$.

To select among the equilibria of game $G(M)$ when the messages in M have a natural meaning, we assume that players have some aversion to lying. Several experiments (e.g. Gneezy, 2005, Sánchez-Pagés and Vorsatz, 2007, Fischbacher and Heusi, 2008, Hurkens and Kartik, 2009, Lundquist et al., 2009, Serra-Garcia et al., 2011 and Eisenkopf et al. 2011), have indeed documented that players dislike lying, but, as typically players do lie whenever this sufficiently increase their payoffs, this aversion does not seem be too strong either. Formally, and adopting a drastic simplification of Kartik (2009), we assume that a player incurs a disutility of ε if the message m, given the state s and the action x is a lie. In other words, given $G(M)$ as above, we consider games $G_\varepsilon(M)$, in which the payoff function of player I is given by

$$u_I^{\varepsilon}(.;m) = \begin{cases} u_I(.) - \varepsilon & \text{if } m \text{ is a lie,} \\ u_I(.) & \text{otherwise,} \end{cases}$$

where $u_I(.)$ is as in (2.1), and in which the payoff function of the uninformed player remains as in (2.1). We have[10]

PROPOSITION 5. *For almost all $\varepsilon > 0$, the cheap talk games with lying costs $G_\varepsilon(M(X))$ and $G_\varepsilon(M(S))$ have a unique equilibrium; specifically,*

(i) if $\varepsilon \neq 1-b$, the game $G_\varepsilon(M(X))$ has a unique Nash Equilibrium given by: $\sigma_a = (0,0)$; $\sigma_c = (1,1)$; $\sigma_b = (1,0)$ if $\varepsilon < 1-b$, whilst $\sigma_b = (1,1)$ if $\varepsilon > 1-b$; $\tau_0 = 0$ and $\tau_1 = 1$.
(ii) if $\varepsilon \neq bv$, the game $G_\varepsilon(M(S))$ has a unique Nash Equilibrium that satisfies the Intuitive Criterion from Cho and Kreps (1987); it is given by: $\sigma_a = (a,0)$; $\sigma_c = (c,1)$; $\sigma_b = (c,0)$ if $\varepsilon < bv$, whilst $\sigma_b = (b,0)$ if $\varepsilon > bv$; $\tau_a = \tau_b = 0$ and $\tau_c = 1$.

Note that in equilibrium, irrespective of ε and of what player I talks about, the types a and c of player I are truthful: they honestly reveal the state and their contribution level, respectively. Trivially, type a never contributes and type c always does. Accordingly, player U contributes when 'good news' is communicated (state c, or a contribution), but only in that case. Type b of player I, therefore, has the choice between lying and pooling with type c, or communicating honestly. When lying costs are small, she chooses the former in both games. The proposition thus tells us that, if lying costs are small but positive, the equilibrium will be influential, with 'natural' messages being used.

Contributions in the two games are only different when lying costs are not small ($\varepsilon > 1-b$), and then only for type b. In $G_\varepsilon(M(S))$, the only way to avoid lying is to reveal the state, but then player U does not contribute, hence, honesty is quite costly: I's payoff drops with bv. If player I talks about her contribution, lies can be avoided in two ways: contributing and telling so, or not contributing and revealing that. The former maintains the contribution of player U, hence, is not as costly as the latter. The net cost is $1-b$, which is smaller than bv. It, therefore, also follows that, if $1-b < \varepsilon < bv$, player I will still lie when she talks about the state, but not when she talks about her contribution. In this case, there is, hence, an interesting difference between the two games, which is also payoff relevant. For even larger lying costs ($\varepsilon > bv$), there will not be lying in any of these games, but contribution behavior of the player U still differs: type b contributes in $G_\varepsilon(M(X))$, but not in $G_\varepsilon(M(S))$.

10. The main elements of the proof are sketched below the statement of the Proposition. The formal proof (see Online Appendix A) is slightly more complicated to deal with mixed strategies. In the case of communication about the state, $M = M(S)$, it relies on the Intuitive Criterion (Cho and Kreps, 1987) in order to eliminate the equilibrium where the message 'the state is b' is used by both higher types ($s = \{b,c\}$).

TABLE 1. Payoff matrices.

		Earnings Table 1			Earnings Table 2			Earnings Table 3	
		Other person's choice			Other person's choice			Other person's choice	
		A	B		A	B		A	B
Your choice	A	40	40	A	40	100	A	40	160
	B	0	0	B	30	90	B	60	180

When formulating our hypotheses in Section 3.2 below, we assume that lying costs are sufficiently small ($\varepsilon < 1 - b$), such that the equilibrium is influential in both games. Thus, we hypothesize the same rate of lying and the same contributions across both languages; in particular, we predict that player I will free ride as much when she talks about the state as when she talks about her contribution. We will see that, although, with this assumption, Proposition 5 organizes the data reasonably well, this latter prediction does not come true: player I contributes more and lies less when she talks about her contribution. One possible rationalization of this observation comes directly from Proposition 5: lying costs may be larger than $1 - b$ but smaller than bv. This is not the only possible explanation, however. One might imagine that certain types of lies are psychologically more costly than other types of lies. Specifically, lying about one's own actions may be perceived to be worse than lying about the state. A possible underlying reason for this might be that a message about the own action might be seen as somewhat of a promise, which player I may not want to break. After having described the experimental design and the results, we discuss these competing explanations in more detail in Section 5, in which we report on an additional experiment that we conducted to separate them.

3. Experimental Design and Hypotheses

3.1. Parameterization and Treatments

In the experiment, the payoff function of our one-shot game is $u_i = 40[1 - x_i + s(x_i + vx_j)]$, where $s = \{0, 0.75, 1.5\}$ and $v = 2$. Subjects are matched with a different player in each period and play the game for 21 periods. Each time they are asked to choose between A (equivalent to $x_i = 0$) and B (equivalent to $x_i = 1$). The payoffs of a player depend on her choice, the choice of the other player and the earnings table selected. The earnings table number (1, 2 or 3) corresponds to the value of s ($s = 0, 0.75$ or 1.5, respectively). Payoffs (in points) are shown in Table 1 for each earnings table. These tables were shown to subjects both in the instructions (reproduced in Online Appendix B) as well as on the computer screens.

There are four treatments, listed in Table 2: Sim, Seq, Words(s), and Words(x). In all treatments, at the beginning of each round, the informed player, named first mover in the experiment, is informed about the earnings table selected, and next decides whether to contribute or not. In Sim, the uninformed player, named second mover, receives no information and is simply asked to make a decision; in Seq the uninformed player

TABLE 2. Experimental design - information structure by treatment.

	Informed player	Uninformed player
Sim	Observes s	No information
Seq	Observes s	Observes x
Words(s)	Observes s	Observes $m \in M(S)$
Words(x)	Observes s	Observes $m \in M(X)$

learns the decision of the informed player (A or B) before making his contribution. In the two treatments with cheap talk communication, Words(s) and Words(x), the informed player is explicitly asked to also select a message to send to the uninformed player. In Words(s), the three possible messages are 'The earnings table selected by the computer is s', where s is either 1, 2 or 3. In this game, the informed player thus talks about the state. In Words(x), two messages are possible: 'I choose A' or 'I choose B'. In this game, the informed player thus talks about (her) contributions. The roles of informed and uninformed player are randomly determined within each pair in each round, each player, hence, gains experience in both roles. The information available in each treatment is detailed in Table 2 below.

In each period, both players have a history table at the bottom of their screens, displaying the following information for each previous period: the earnings table that was selected, the role of the player, the own decision and that of the other player, including the message sent if applicable, and the earnings of both players. From this information, players could not identify the players with whom they had previously played.

3.2. Experimental Procedures

Four matching groups (of 8 subjects each) participated in treatments Sim and Seq. In treatments Words(s) and Words(x) there were eight matching groups. Four matching groups belong to sessions conducted first (Nov. 2008), while four additional matching groups were run later (May 2011), together with two new treatments that will be discussed in Section 5.[11] Subjects were re-paired every period with another subject in their matching group and roles were randomly assigned. Since there were 8 subjects in each matching group, each subject met the same person at most 3 times, but never in two consecutive periods in the same role. Overall, 84 pairings were obtained per matching group (4 pairs x 21 periods): 25 faced Earnings Table 1, 30 Earnings Table 2 and 29 Earnings Table 3.[12]

The experiment was programmed and conducted with the software z-Tree (Fischbacher, 2007). It was conducted in CentERlab, at Tilburg University. Subjects

11. The eight matching groups are pooled in the analysis below, since no significant differences are found in the main variables across the sessions conducted earlier and later.

12. The matching schemes, roles and states of nature for each period and pair were randomly drawn before the experiment. This allowed us to have the same exact patterns across different matching groups.

received an invitation to participate in the experiment via e-mail. They could enroll online to the session of the experiment, which was most convenient for them, subject to availability of places. Subjects were paid their accumulated earnings in cash and in private at the end of the experiment. Average earnings were €12.22 (sd: 2.43) and sessions lasted approximately 60 minutes.

3.3. Hypotheses

Our hypotheses are derived from Propositions 1 and 2 (for the two benchmark games) and from Proposition 5, together with the assumption that lying costs are small but positive ($0 < \varepsilon < 1 - b$) for the two games with cheap talk communication. Let us first look at the contributions of player I. The informed player never contributes when s =0, and always does when s=1.5. When s=0.75, she only does in Seq, that is, if her contribution is observed. Focusing on the intermediate state, s =0.75, we, therefore, have:

HIPOTHESIS 1 (Informed player contribution behavior). *When s=0.75, the informed player contributes*

(a) *more frequently in Seq than in Words(s) or in Words(x);*
(b) *with equal frequency in Words(s) as in Words(x);*
(c) *with equal frequency in Sim as in Words(s) and Words(x).*

Let us now turn to the communication behavior of the informed player. Proposition 5 tells us that player I will tell the truth in the lowest and highest state, but will lie in the intermediate one, where she will use the same message as in the high state. As a result of partial pooling, the same information is communicated with cheap talk as in the game with sequential moves.

HIPOTHESIS 2 (Message use and information transmission).

(a) *When s=0, the most frequent message in Words(s) is 'the state is 0', while in Words(x) it is 'I do not contribute'; when s=0.75 or s=1.5, the most frequent message is 'the state is 1.5' in Words(s) and 'I contribute' in Words(x);*
(b) *the same information is transmitted in Words(s), Words(x) and Seq.*

Let us now turn to the uninformed player. His behavior ranges from never contributing (as in Sim) to imitating the informed player (in Seq). Since he acquires the same information in the communication treatments as in Seq, we predict that, when cheap talk is allowed, he will contribute as often as in Seq.

HIPOTHESIS 3 (Uninformed player contribution behavior). *The messages 'the state is 1.5' and 'I contribute', in Words(s) and Words(x), respectively, are as influential in eliciting a contribution of the uninformed player as a contribution of the informed player is in Seq.*

Finally, we can look at efficiency.[13] We have seen that efficiency is lowest when there is no communication, that it reaches 100% in Seq, and that it is in between in the communication treatments. Specifically, the efficiency (ξ) of each treatment can be ranked as follows: ξ_{Sim} (61.3%) $\leq \xi_{Words(s) \text{ and } Words(x)}$(91.9%) $< \xi_{\text{Seq}}$ (100%). These inequalities lead to Hypothesis 4.[14]

HIPOTHESIS 4 (Efficiency). *Efficiency*

(a) *is highest under Seq, compared to all other treatments;*
(b) *under Words(s) is equal to that under Words(x);*
(c) *is higher in Words(s) and Words(x) than in Sim.*

4. Results

Motivated by the fact that, for s=0.75, informed players exhibit strong learning in the first 10 periods, we report results from the second half of our experiment (periods 11 to 21). Our unit of observation will be each matching group. Throughout we will use nonparametric two-sided tests performed on the average by matching group, unless mentioned otherwise. The raw data, at the matching group level, is provided in Online Appendix C.[15] The same qualitative results are obtained employing regression analysis, as reported in Online Appendix D.

4.1. Contributions by the Informed Player

Figure 1 below displays the average frequency with which player I contributes, conditional on state and treatment. The four leftmost columns show that, when s=0, player I hardly contributes. In contrast, when s=1.5, she contributes more than 92% of the time. In state s=0 and state s=1.5 there is no significant difference across treatments (Kruskall-Wallis test, p-value=0.28 and 0.65, respectively). These observations are in line with the theoretical predictions.

Treatment differences become significant when s=0.75. As predicted, player I contributes significantly more often (81% of the time) when her contribution is observed, than in any other treatment (Mann-Whitney (MW) test, p-value=0.02 comparing Seq and Sim; p-value <0.01 comparing Seq and Words(x) or Seq and Words(s)). However, in contrast to the theoretical prediction, player I's contribution is also affected by the words she can use: when she talks about her contribution decision,

13. Efficiency is calculated throughout the paper as the sum of payoffs of the leader and the follower in each treatment, divided by the maximum sum of payoffs attainable.

14. We do not formulate a hypothesis about payoffs since the treatment effects are expected to be small for the informed player's payoffs. We briefly discuss predicted and actual payoffs in Section 4.4.

15. The z-tree programs, the data file, at the individual level, and the do-file used to generate in results in Sections 4 and 5 are provided in the Supplementary Material of this paper, available online.

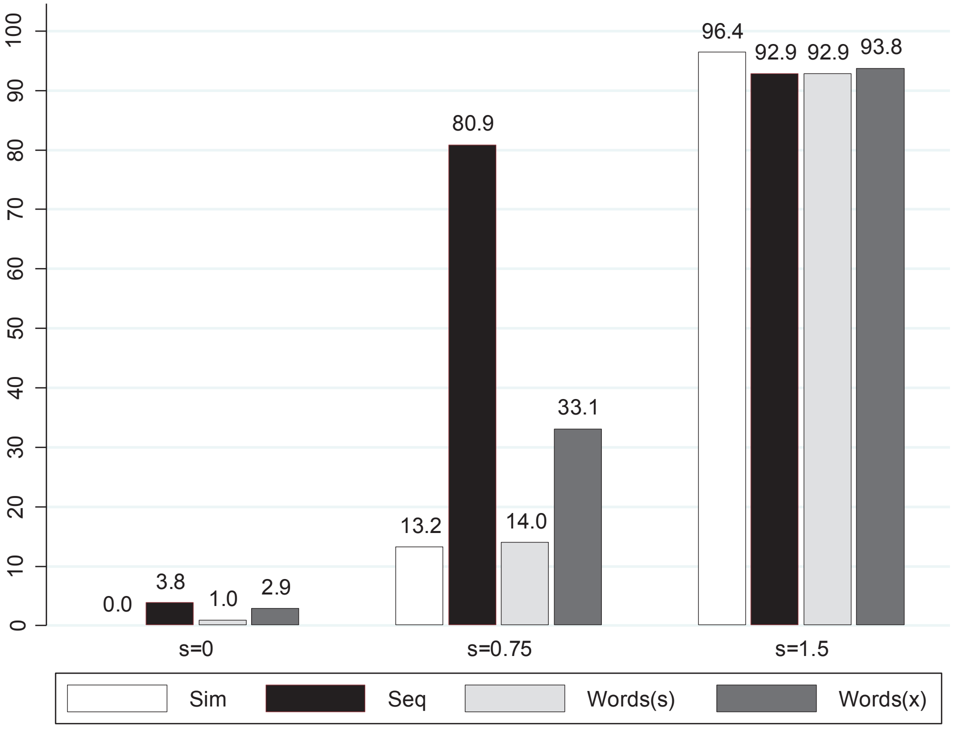

FIGURE 1. Contribution frequency by informed player, by treatment and state.

she contributes more than twice as often than when she talks about the state (33.1% versus 14%; MW test, p-value=0.03). Further, the contribution rate in Sim does not differ from that in Words(s) (MW test, p-value=0.86), but it does differ from that in Words(x) (MW test, p-value=0.03).

RESULT 1 (Contributions of the informed player).

(a) When $s = 0.75$, the informed player's contribution is higher in Seq than in Words(s) and in Words(x). Thus, we do not reject Hypothesis 1 (a).

(b) The contribution frequency of the informed player is affected by the language that is available. The informed player contributes more often when sending messages about her contribution (Words(x)), than when she sends messages about the state (Words(s)). We, thus, reject Hypothesis 1 (b).

(c) The informed player contributes as frequently in Sim as in Words(s), but less frequently in Sim than in Words(x). Thus, we reject Hypothesis 1(c).

Hence, it matters what the informed player can talk about. An open question that remains is why. Is it because individuals have higher lying costs than hypothesized? Or because lying costs depend on the language available? We will examine the reason behind the rejection of Hypothesis 1(b) and (c) using additional experimental evidence

TABLE 3. Message use in Words(s) and Words(x), by treatment and state.

Treatment	Message (m)	Message use[a] s=0	s=0.75	s=1.5
Words(s)				
	'the state is 0'	77.9%	4.4%	0.9%
	'the state is 0.75'	9.6%	20.6%	3.6%
	'the state is 1.5'	12.5%	75.0%	95.5%
Words(x)				
	'I do not contribute'	86.5%	27.2%	12.5%
	'I contribute'	13.5%	72.8%	87.5%

a. Number of times m is sent over total number of times that s is drawn.

in Section 5. Before doing so, we first analyze (in Section 4.2) the use of messages by the informed player, the information transmitted through these messages, and (in Section 4.3) the reaction of the uninformed player, and the efficiency that is achieved (Section 4.4).

4.2. Message Use and Information Transmission

Table 3 displays the frequency with which player I uses a message in each state. When s=0, in Words(s), she most frequently sends the message 'the state is 0' (77.9%), while in Words(x), she most frequently says 'I do not contribute' (86.5%). When s=1.5, the most frequent messages are 'the state is 1.5' (95.5%) and 'I contribute' (87.5%) in Words(s) and Words(x), respectively.

If s=0.75 and player I talks about the state, she very often hides the truth by sending the message 'the state is 1.5' (75.0%). At the same time, in 20.6% of the cases player I truthfully reveals the state. This truthfulness implies that the message 'the state is 1.5' is used more frequently in state 1.5 than in state 0.75 (Wilcoxon signed-rank (WSR) test, p-value=0.02).

If s=0.75 and player I talks about her actions (Words(x)), she most frequently sends the message 'I contribute' (72.8%), whilst she sends the message 'I do not contribute' over a quarter of the times (27.2%). This leads to a marginally significant difference in the use of the message 'I contribute' across s=0.75 and s=1.5 (WSR test, p-value= 0.09).

Messages in Words(x) can only be identified as truthful in combination with the informed player's contribution decision. If we take her contribution into account, we find that, when $s = 0.75$, the informed player is truthful in 41.1% of the cases, hence, twice as often as in Words(s), 20.6% (MW-test, p-value=0.06).

By using Bayes' rule, message use can be translated into information transmitted to the uninformed player. In Table 4 we display the posterior probability that the state is s, given the signal received, based on the informed player's behavior during periods 11 to 21.

After a contribution (x=1 in Seq) or after a positive signal ('the state is 1.5' in Words(s); 'I contribute' in Words(x)) the posterior probability that the state is 0.75

TABLE 4. Posterior probability of each state conditional on signal by informed player.

Treatment	Signal	Probability that s=0	s=0.75	s=1.5
Seq	Informed player's decision			
	x=0	0.75	0.18	0.06
	x=1	0.02	0.5	0.48
Words(s)	Message about the state			
	'the state is 0'	0.93	0.06	0.01
	'the state is 0.75'	0.13	0.70	0.17
	'the state is 1.5'	0.06	0.45	0.49
Words(x)	Message about the contribution			
	'I do not contribute'	0.66	0.25	0.09
	'I contribute'	0.07	0.46	0.47

and the posterior probability that the state is 1.5 are both very close to 0.5, and not significantly different across treatments.[16]

After no contribution (x=0 in Seq), the posterior probability that the state is 0 is 0.75. It is somewhat higher (0.93) after message 'the state is 0' in Words(s) (MW test, p-value=0.03), and not significantly different (0.66) after message 'I do not contribute' in Words(x) (MW test, p-value=0.15).

RESULT 2 (Message use and information transmission).

(a) In Words(s), the message 'the state is 0' is most frequently used when $s = 0$, *while the message 'the state is 1.5' is most frequently used when* $s = 0.75$ *or 1.5. In Words(x), 'I do not contribute' is most frequently used when* $s = 0$, *and 'I contribute' is used most often when* $s = 0.75$ *or 1.5. We therefore do not reject Hypothesis 2a.*

(b) Compared to a contribution decision in Seq, the message 'the state is 1.5' in Words(s), or the message 'I contribute' in Words(x) does not convey significantly different information. Compared to no contribution in Seq, the message 'I do not contribute' also does not convey significantly different information, while the message 'the state is 0' signals somewhat more strongly that the state is 0. With the exception of the latter, we do not reject Hypothesis 2b.

4.3. Contributions by the Uninformed Player

Table 5 displays how the uninformed player reacts to the information transmitted by the informed player. Column (1) gives the average contribution frequency of the uninformed player, conditional on the signal received. Columns (2) and (3) give the expected payoff in points from not contributing, or contributing, calculated using the

16. The p-values resulting from the MW test comparing Seq and Words(s) are 0.15, if s=0.75, and 0.73, if s=1.5; comparing Seq and Words(x), 0.23, if s=0.75, and 0.93, if s=1.5; and comparing Words(s) and Words(x), 0.96, if s=0.75, and 0.46, if s=1.5.

TABLE 5. Uninformed player's contribution frequency, expected payoffs and best reply, by treatment.

Treatment	Signal	(1) Uninformed Player's Contribution Frequency	(2) Expected Payoffs $\pi(y=0)$	(3) Expected Payoffs $\pi(y=1)$	(4) Empirical best reply
Sim	-	39.2%	81.22	71.22	$y=0$
Seq	$x=0$	4.4%	40.00	9.27	$y=0$
	$x=1$	88.0%	127.77	131.65	$y=1$
Words(s)	'the state is 0'	5.3%	41.84	4.30	$y=0$
	'the state is 0.75'	52.7%	62.89	54.00	$y=0$
	'the state is 1.5'	60.8%	98.61	101.62	$y=1$
Words(x)	'I do not contribute'	13.1%	52.70	25.77	$y=0$
	'I contribute'	52.8%	103.62	105.81	$y=1$

posterior probabilities displayed in Table 4, as well as (for Words(s) and Words(x)), the frequency with which the informed player contributes conditional on each message sent. The last column of Table 5 displays the empirical best reply, based on the expected payoff calculation.

Comparing columns (1) and (4) reveals that in almost all cases the contribution rate of the uninformed player is larger than 50% if and only if the empirical best reply is to contribute. In fact, relating the contribution frequencies to the expected payoff gains from contributing, column (3) - column (2), gives a strong correlation (the Spearman rank correlation is 0.7848). This is in line with previous work showing that individuals make mistakes, but that costly mistakes are less likely than cheap mistakes (McKelvey and Palfrey, 1995).

Let us look at some of the figures in more detail. The first row indicates that in the Sim treatment the uninformed player contributes in 39.2% of the cases. This is remarkably close to the contribution rate (34.0%) reported by Potters et al. (2007) for a very similar game, as well as Ellingsen and Johannesson (2004), who find that 35% of sellers invest in an investment game without communication, despite the prediction of no investment. Possibly, social preferences play a role. After all, with an expected value of s of 0.75, it is socially efficient to contribute. Still, a positive contribution rate goes against the theoretical prediction (Proposition 1).

In Seq, after observing a contribution by the informed player, the uninformed player contributes 88% of the time. In Words(s) and Words(x), the informed player also contributes in the majority of the cases (60.8% and 52.8%), after the messages 'the state is 1.5' and 'I contribute'. These contribution frequencies are lower than after observing $x=1$ in Seq (MW test, p-value=0.04, comparing the message 'the state is 1.5' and $x=1$ in Seq, and 0.01, comparing 'I contribute' and $x=1$ in Seq).

RESULT 3 (Contributions of the uninformed player). *The uninformed player frequently contributes after observing the contribution of the informed player (88.0%), or after hearing the message 'the state is 1.5' (60.8%), or after the message 'I contribute' (52.8%). However, the reaction to the messages 'the state is 1.5' and*

'I contribute' is significantly weaker than the reaction after a contribution. Therefore, we reject Hypothesis 3.

Why are contribution rates higher after a contribution in Seq than after the message 'the state is 1.5' in Words(s) or 'I contribute' in Words(x)? While the information transmitted by these messages is not significantly different to that after a contribution, uninformed players may dislike the fact that the messages 'the state is 1.5' or 'I contribute' are often lies. As shown in other studies, such as Brandts and Charness (2003), Sanchez-Pages and Vorsatz (2007) and Eisenkopf et al. (2011), receivers dislike being lied to and react by punishing deceptive lies. In our experiment, uninformed players may anticipate that the messages 'the state is 1.5' or 'I contribute' are often lies, and avoid the disutility of contributing after being lied to, by not contributing.[17] Another possibility is that the uninformed player is averse to payoff inequality (Fehr and Schmidt, 1999). After observing a contribution by the informed player, by contributing, the uninformed player can equalize both players' payoffs. In contrast, after receiving the message 'the state is 1.5' or 'I contribute', the uninformed player may realize that that there is about a 50% probability that the state is 0.75 in which case the informed player probably did not contribute. Therefore, by contributing, the uninformed player cannot be sure to equalize payoffs and may be left with payoffs lower than those of the informed player. By choosing not to contribute, the uninformed player can avoid such disadvantageous payoff inequality.

4.4. Payoffs and Efficiency

In Table 6 below we display average payoffs and efficiency, by treatment. We also display the corresponding theoretical predictions.

In Sim the informed player earns higher payoffs than predicted, due to the fact that uninformed players contribute in 39% of the cases. In contrast, she does worse than predicted in all treatments in which there is signaling. In Seq, this is mainly due to player I herself not always contributing when s=0.75. In the treatments Words(s) and Words(x), the main cause is the weak following by the uninformed player. Surprisingly, the informed player does significantly worse in Words(x) compared to Seq (MW test, p-value=0.03). In fact, although the differences are not significant, the informed player does slightly worse in Words(x) than in Words(s), since she contributes more often but is followed less.

The uninformed player's payoff comes close to the theoretical prediction in most cases. As expected, he earns a significantly lower payoff in Words(s) and Words(x) than in Seq (MW test, p-value $<$0.01 in both cases).

Taking both players' payoffs together, we turn to efficiency. In line with Hypothesis 4(a), efficiency is highest in Seq (89.1%), in which it is significantly higher than in

17. We find some evidence for this in that the uninformed player is less likely to contribute after having heard a lie in the past in Words(x). We do not find a similar effect in Words(s) though.

TABLE 6. Average payoffs and efficiency, by treatment.

	Informed player's average payoff		Uninformed player's average payoff		Efficiency	
Treatment	Observed	Predicted	Observed	Predicted	Observed	Predicted
Sim	73.24	46.36	78.01	78.18	72.8%	61.0%
	(1.97)		(2.25)		(0.02)	
Seq	89.72	103.86	95.40	103.86	89.1%	100.0%
	(2.74)		(3.30)		(0.02)	
Words(s)	79.35	107.73	78.13	80.68	75.8%	91.9%
	(14.23)		(7.02)		(0.08)	
Words(x)	72.64	107.73	82.61	80.68	74.7%	91.9%
	(13.24)		(8.24)		(0.09)	

Note: Standard deviations in parentheses.

Words(s) (75.8%) and Words(x) (74.7%); (MW test, p-value <0.01 in both cases). Comparing Words(s) and Words(x), there is no significant difference in efficiency (MW test, p-value=0.83), as hypothesized in 4(b). If we compare Sim to Words(s) and Words(x), we find that Sim has the lowest efficiency (72.8%). This is however not significantly different to the efficiency in Words(s) and Words(x) (MW test, p-value=0.39, in both cases). This seems to be mainly driven by the two unexpected features in the uninformed player's behavior: the significant frequency of contributions in Sim, and the weaker than hypothesized contribution frequency in Words(s) and Words(x).

RESULT 4 (Efficiency).

(a) Efficiency is highest under Actions, as predicted. We therefore do not reject Hypothesis 4 (a).

(b) Efficiency is not significantly different in Words(s) and Words(x). We therefore do not reject Hypothesis 4 (b).

(c) Efficiency is not significantly different in Sim compared to Words(s) and (x). We thus reject Hypothesis 4(c).

5. Discussion

One of the most remarkable results that we obtained is that, when the informed player talks about her contribution, she contributes more often than when she talks about the state; in the intermediate state, the contribution frequency is 33.1% in Words(x), but only 14% in Words(s). This result (Result 1(b)) runs counter to Hypothesis 1(b). In this section we explore two possible explanations for why the contribution frequencies may depend on the language available. Hypothesis 1(b) is based on Proposition 5, together with the assumption that lying costs are positive but small. Recall, however, that the condition for lying costs to be small depends on what words are available; in game $G_\varepsilon(M(X))$ the requirement is $\varepsilon < 1 - b$, while in $G_\varepsilon(M(S))$ the condition is $\varepsilon < bv$. Using the parameter values used in our experiment ($b = 0.75$, $v = 2$, and all payoffs multiplied by 40), this corresponds to $\varepsilon < 10$ for Words(x), and $\varepsilon < 60$ for Words(s). These conditions reflect the different costs to avoid a lie. In Words(x), the informed player can avoid lying when the state is intermediate by sending the message 'I contribute' and actually contributing. As earnings table 2 in Table 1 shows, this reduces the informed player's payoff from 100 to 90. In Words(s), the only way to avoid a lie when the state s=0.75 is to actually say so. In response, the uninformed player will not contribute, which reduces the informed player's payoff from 100 to 40. Hence, one potential explanation for Result 1(b) is that, for some subjects, lying costs fall in the intermediate range ($10 < \varepsilon < 60$) so that they will contribute in Words(x) when s=0.75 but not in Words(s).

Lying costs being larger than we assumed, however, is not the only possible explanation for why the contributions of the informed player vary between the two cheap talk games. A second potential explanation is based on the assumption that the informed player may have a taste for keeping her word. Ellingsen and Johannesson (2004) and Miettinen (2008) proposed models in which players suffer a disutility if they do not act as they announced or promised to do, and Vanberg (2008) provided evidence that people have a preference for keeping promises per se.

Saying 'I contribute' is not the same as 'I promise that I will contribute'. Still, we cannot rule out that participants in the experiment viewed 'I contribute' as involving a promise (see Hanfling, 2008, for a philosophical argument). Promises are usually taken to refer to statements about what someone will do or to something that will happen. Saying 'the state is 1.5' sounds more factual and subjects may have seen this as resembling a promise to a lesser extent.[18] If individuals dislike breaking promises, and view statements about their actions as promises, they might be more reluctant to lie about their actions than about their information. We conducted an additional treatment to distinguish between these two alternative explanations.[19]

In this treatment, labeled 'Report(x)', we completely eliminated the promise content that might implicitly have been present in messages in Words(x). To do so, we allowed the informed player to send a message only *after* having decided about contribution (in a separate screen, which also displayed the contribution that she had chosen). She could then send the messages 'I have not contributed' or 'I have contributed'. Clearly, with these messages, the resemblance to a promise is very remote: player I just 'reports' on his contribution. For the rest, the protocol was exactly the same as in Words(x).

18. Note that the literal message available in the experiment in Words(s) was 'the earnings table selected by the computer is s', which refers to something that happened in the past, and not to something that will happen in the future.

19. As pointed out by a referee, another difference between Words(s) and Words(x) is that the number of messages differs across these treatments. To address this issue, we ran an additional treatment (with 32 subjects and 4 independent matching groups). In this treatment, the informed player could send only two messages: 'the state is 0 or 0.75' or 'the state is 1.5', which preserves the same conflict between truth-telling and contributing if s=0.75. Our results reveal that the number of messages does not make a significant difference, i.e., the contribution frequency of the informed player if s=0.75 in this treatment (23%) is not significantly different from that in Words(s) (14%) (MW-test, p-value=0.2611)

TABLE 7. Contribution frequency by the informed player in Report(x), compared to Words(s) and Words(x).

Treatment	State s=0	s=0.75	s=1.5
Report(x)	0.0%	17.6%	91.1%
Words(s)	1.0%	14.0%	92.9%
Words(x)	2.9%	33.1%	93.8%

Note that, also in Report(x), the informed player can cheaply avoid lying by simply contributing in the intermediate state. Consequently, if the informed player contributes less often when s=0.75 in Report(x) than in Words(x), the effect of language on contributions can be attributed to the implicit promise component of the messages in Words(x). In contrast, if contributions remain the same, this would suggest that the higher contribution frequency in Words(x) is due to the fact that lying can be avoided more cheaply than in Words(s).

The first row of Table 7 displays the informed player's contribution frequency by state in Report(x). For comparison, the contribution frequencies in Words(s) and Words(x) are displayed as well. If s=0 or s=1.5, there is hardly any difference between these treatments. If s=0.75, the informed player contributes in 17.6% of the cases, which is not significantly different from Words(s) (14%) (MW-test, p-value=0.86), but is significantly lower than in Words(x) (33%) (MW-test, one-sided, p-value=0.06). Therefore, eliminating the implicit promise component significantly reduces the contributions by the informed player.[20] This suggests that the higher contribution frequency in Words(x) is driven by the promise content of messages about one's contribution decision. It is in line with Brosig et al. (2005), who find that individuals lie more about past behavior than about their future intentions in face-to-face communication. In our experiment finding such a result is especially remarkable, since messages do not contain explicit promises and since the messages are pre-written, which may potentially restrict the power of promises.[21]

20. Other aspects of behavior in Report(x) are not significantly different from those in Words(s) and Words(x). When s=0, the informed player most frequently sends the message 'I have not contributed' (75%), while when s=0.75 or 1.5, she most frequently sends the message 'I have contributed' (88.2% and 89.3% of the cases). Thus, the message 'I have contributed' is used in a similar way as were the messages 'I contribute' and 'the state is 1.5' in the original experiment (see Table 2). The contribution frequency of the uninformed player after message 'I have contributed' (49%) is not significantly different either from that after messages 'the state is 1.5' (60.8%) or 'I contribute' (52.8%) (MW-test, p-value=0.31 and 0.61, respectively).

21. Existing studies on games with complete information show mixed results when communication about intentions is restricted, as in our case, to pre-formulated messages. Such restricted communication does not increase cooperation or trust in some studies (e.g. Bochet et al, 2006, and Charness and Dufwenberg, 2010), while it does in others (e.g. Duffy and Feltovich, 2002). See Balliet (2010) for meta-analysis, as well as the reviews by Bicchieri and Lev-On (2007) and Koukoumelis et al (2009), and the references therein.

RESULT 5. *The exact phrasing of messages about actions matters. When messages are reports regarding chosen actions ('I have contributed'), the informed player contributes significantly less often when $s = 0.75$, than when messages are about 'current' activity ('I contribute'); apparently the latter type of messages are viewed to have an implicit promise component.*

6. Conclusion

In the context of a two-player, one-shot, public good game in which only one player is privately informed about the return from contributing, we study the impact of cheap talk communication. We examine two languages: one in which the informed player can talk about her private information and one in which she can talk about her contribution. We compare the effect of these words, on both the informed and the uninformed player, to two benchmark cases: the case where no signaling is available and the case where the informed player's contribution is observed by the uninformed player. Theoretically, in the former case, contributions by both players are inefficiently low, while in the latter case a fully efficient equilibrium is obtained.

In our game, words allow for two types of equilibria: babbling equilibria, in which messages are ignored, and influential equilibria, in which the uninformed player is affected by messages. Assuming that the informed player faces a small cost of lying enables us to predict which messages will be sent and show that only the influential equilibrium survives. An interesting feature of the equilibrium is that in the intermediate state the informed player sends an untruthful message, which induces the uninformed player to contribute, while the informed player free-rides. This outcome is independent of the language used. When talk is about her information, the informed player will say 'the return is high' when in fact the return is intermediate. When talk is about actions, the informed player will say 'I contribute' when in fact she does not contribute.

In sharp contrast to the theoretical prediction, we find that it matters whether messages are about the return to the public good, or about the contribution of the informed player. Informed players free-ride less, and also lie less, when talking about their contribution. We advance two possible explanations: first, the fact that it is less costly to avoid lies about contributions than about private information, and, second, a stronger desire to keep a promise than to reveal truthfully what one knows. We present additional experimental evidence in favor of the latter explanation. In particular, when informed players are allowed to send a message about a contribution decision they have made already, thus eliminating the promise element of the message, the contribution frequency drops to the level observed when talk is about the return.

Some have argued that the moral obligation to tell the truth and to keep a promise both arise from the 'requirement of veracity' (Warnock, 1971). Just as I should say what I have done, so I should say what I will do. What is required in both cases is agreement between statement and fact. But the comparison is less than perfect. A difference is that in the former case the 'fact' is still within the control of the speaker, whereas in the former case it is not. Possibly, the speaker feels less responsible for the agreement of statement and fact when there is nothing (s)he can do about the fact. When the statement is about the speaker's own intended behavior, on the other hand, it is more difficult to decline responsibility for the 'fact'. This may be a reason why the costs of lying about facts are lower than those of lying about intentions. Perhaps there is more 'moral wiggle room' in the former case, much like there is when one can deny responsibility for an immoral decision (Dana et al., 2007) or delegate it to someone else (Hamman et al., 2010).

A natural hypothesis is that in games with asymmetric information the impact of signals derives from the information they transmit about the state. Our experimental results show that there may be more to it than that. Firstly, in our two communication treatments (Words(s) and Words(x)) the informational content of the messages ('the return is high' and 'I contribute') is almost the same, as is the response by the receiver. We find a difference, however, in the sender's behavior, who is more likely to cooperate in case she sends a message about what she does than about what she knows. Secondly, the information transmitted about the return of the public good by a message in the two communication treatments is the same as the information transmitted by a contribution in the benchmark game with sequential moves. Still, the uninformed player contributes less frequently in the former than in the latter game. This suggests that what matters for the uninformed is not only what a signal tells about the private information of the sender, but also for what it tells about the action of the sender. In sum, signals do not only transmit information, they also have a direct impact on the sender's actions, which in turn may affect the receiver.

To study communication about what one knows and what one does in a unified framework, we have used a setting in which an informed player does not only send a message but also takes an action that affects the receiver directly. This seems relevant in many situations. A team leader, who is better informed about the productivity of effort than other members, also chooses an effort level herself. A lender, with better information about the financial situation of a borrower than other creditors, also has to set loan terms. A wealthy philanthropist, who knows more about the quality of a charity than less affluent donors, also makes donations herself. In those cases, communication can facilitate cooperation, but may also lead to deception and free-riding. Our results suggest that mutually beneficial cooperation is best served by the informed player moving first (leading-by-example). This rules out free-riding by the informed player and leads to effective information transfer. When the actions of the informed player cannot be observed though, the informed player is more trustworthy in case she has to talk about what she does, than in case she can talk about what she knows.

In our study we compare the effect of talk about private information and talk about actions by fixing the available language exogenously (as might be relevant in legal procedures or organizations in which a strict communication protocol can determine the language available). A natural and interesting extension would be to allow the informed player to choose the language she wants to use. In such a case not only the content of the message could be informative but also the subject of the message. One could also allow the informed player to choose between moving first or sending a message. In such a setting, part of the message might be in the choice of medium. It is not clear what will happen in those settings. What is clear though is that talk is no longer cheap when there is a cost of lying. Moreover, as our paper illustrates, its costs may depend on the language of the message, the content of the message, and the actions chosen by the sender.

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