NEVER RETREAT, NEVER SURRENDER: THE BARGAINING POWER OF COMMITMENT IN THE HAWK-DOVE GAME.

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Abstract

This paper studies experimentally the conditions that improve bargaining power using threats in a negotiation process. Following Schelling's (1960) ideas we choose the *hawk-dove game* because is the simplest negotiation environment with inequity distribution in equilibrium. The analysis is focused on three essential elements of commitment: the possibility of a player to announce his own actions, the credibility of these messages and the experience acquired in the negotiation process. The empirical evidence shows that, in the first period, subjects do not realize the bargaining power of commitment. When the game is repeated and experience increases, subjects gradually understand the advantages of a threat, turning the payoffs into their favor. Credibility is also relevant for the relation, if subjects can choose their message, it is common to find strategic liars, and their rivals punish this behavior.

Keywords: Credible threats, negotiation, experiments.
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1. INTRODUCTION

A player can increase his bargaining power in a negotiation process if he decide to bind himself in a credible way, rejecting with premeditation some opportunities. The lack of freedom of a player has strategic value because it changes the expectations that others have on the future answers that he could give, and this restriction can be used in his own benefit. It is easy to identify examples of commitment in daily life or economic situations, but military strategy is the most salient case because conflict is inherent to it. Announcing that our army is ready to fight up to the last breath is essential to deter an opponent from entering into a bloody battle, since what is looked for is that the rival gives himself up without wasting valuable resources. Clearly, it is common that these announcements are not for free. In the case of the conquest of Mexico, Hernán Cortés burned his own ships to report that his army was not ready to go back without the victory (Dixit and Nalebuff, 1993).

Another close example is the quote "never retreat, never surrender" in the movie *300* by the director Zack Snyder. In that story the Spartan army is willing to sacrifice a small number of their best soldiers in order to deter the Persian army. This strategy is clearly a credible threat. As was illustrated by Schelling (1956) "when one threatens to fight if attacked or to cut his price if his competitor does, the threat is no more than a communication of one's own incentives, designed to impress on the other the automatic consequences of his act".

In Schelling's (1960) seminal work, he distinguishes between two different types of commitment: ordinary commitment and threats. The ordinary commitment is the possibility of playing first, announcing that our decision has already been taken and that it is impossible to be changed, which forces the opponent to take the final decision. This is the case of the famous military strategy "burn the ships" illustrated above. On the other hand, threats occur when the second mover convincingly pledges to respond, in a specified contingent way, to the opponent's earlier choice (Hirshleifer, 2000).

The distinctive feature of a threat is that the sender has no incentive to carry it out either before the event or after. This leads us to questioning the credibility of this strategic movement, because announcing that a player is going to play in an opposite way to the game incentives does not change the opponent's beliefs. The message "never retreat, never surrender" is not enough to increase the bargaining power; it is necessary that the specified action is actually the one that will be played. A message is credible if it makes clear to the opponent that the play cannot change, because it is too costly or even impossible to turn back[1].

The way of communicating the action plan and the credibility mechanism are two essential elements to make a successful commitment. In the battle of Thermopylae, the king Xerxes personally spoke with Leonidas, offering him wealth and power in exchange for his loyalty and surrender. Leonidas refused the offer, understanding the high cost of his choice. In this example, the threat is successful because the 300 soldiers were willing to die in the battle field, showing that their words coincide with their real actions. However, they understood the importance to send a messenger back in order to relate how the Persian army is depleted by desertions, out of fear, inspiring the different Greek city-states to unite against the Persians.

Some hypotheses on the commitment theory have been tested previously. Güth, et al. (1998) and Huck and Muller (2005) study the positional order effect, and the advantages of burn money in the battle of the sexes game. With the same approach, Güth, et al. (2006) studies the strategic

[1] Briefly we can highlight some mechanisms to reach a credible commitment, which are discussed widely in the literature on contracts and negotiation. The mechanism analyzed in this paper consists of changing the game in such a way that the possibility to cheat could be limited. The most radical situation is to reject any opportunity to go back. Another possibility consists of changing the game payoffs, which can be implemented by rewards or punishments, or by destroying own payments. Finally, it is possible to use other people to support the commitment. A team can be easily more credible than an individual. See Dixit and Nalebuff (1993).

behavior of leaders and followers in sequential duopoly experiments with imperfect movement observations. Fischer, et al. (2006) and Poulsen and Tan (2007) test the information transmission in the ultimatum game. More recently, Poulsen and Roos (2010) focus their analysis in the strategic information avoidance in the Nash bargaining game. However, the way of communicating a self-serving threat and their credibility remain being less studied

Our paper contributes to this literature in two ways. First, we use a novel experimental design to specify when a threat can increase a player's bargaining power. We use the *hawk-dove game* with perfect information because is a stylized representation of preemption and deterrence, and it is the simplest situation to test the backward induction reasoning necessary to calculate the equilibrium. Second, we define three different treatments related with the strategic role of communication, *without*, *commitment* and *non-binding messages*. Each treatment separates the particular effect of messages and credibility on the final outcome.

In the experimental literature, Rubinstein's model (1982) and ultimatum game are the most popular environments to study bargaining. The evidence by Binmore, Shaked, and Sutton (1985) supports the non-cooperative view that outside threats affect bargaining divisions only if divisions themselves make it credible for players to exercise the threat. Ochs and Roth (1989) ran a more complex experiment, but their focused on the effects of different discount rates. The ultimatum game is the base for studding bargaining using perfect information (Bolton, 1991; Fehr and Schmidt, 1999; Bolton and Ockenfels, 2000; among others) and also with imperfect information (Mitzkewitz and Nagel, 1993; Kagel et al., 1996; Straub and Murnighan, 1995; Croson, 1996).

The effectiveness of communication to reach efficient outcomes has been a topic of great controversy. It is clear that without communication the efforts to reach the efficiency in coordination games or social dilemmas are slightly effective. Cooper, et al (1992) presents experimental evidence on the importance of non-binding messages in coordination games. Charness (2000) shows that by modifying the order of the choice between the message and the action changes players' behavior. Forsythe et al. (1991) ran a bargaining game and found no significant effect of communication via cheap talk. In contrast, Valley et al. (1998) found that cheap talk helps bargainers. Also a wide discussion exists on the efficiency of the previous communication to reach higher levels of contribution to a public good. Wilson and Sell (1997) shows that the simple communication, information about the past behavior or some combination of the two may not always be useful for solving social dilemmas.

As Bolton (1998) suggested, bargaining and dilemma games have developed in experimental economics as fairly separate literatures. For bargaining, the debate has centered on the role of fairness and the nature of strategic reasoning. For dilemma games, the debate has involved the relative weights that should be given to strategic reputation building, altruism, and reciprocity. Our experimental design and the commitment approach could be the way for building this bridge, because in the same structure we can study all this elements at the same time.

Given the characteristics of the *hawk-dove game*, this paper is focus on the following questions: Do people take advantage of commitment opportunity in order to manipulate their opponents' behavior? Is the outcome efficient under the different communication mechanisms? Is experience in the bargaining process necessary to implement the threat strategy? The comparison between a negotiation with and without commitment shows that, in the first period, subjects do not realize the bargaining power of commitment. When the game is repeated and experience increases, subjects gradually understand the advantages of a threat, turning the payoffs into their favor. For an additional control, we analyze the negotiation with cheap talk messages. Would people lie strategically to turn the agreement into their favor? The comparison between the *commitment* and *non-binding messages* shows that credibility is also relevant, because when subjects can choose their message, it is common to find strategic liars, and their rivals punish this behavior.

The paper is organized as follows. In the second section the experimental design is described, highlighting the hypotheses on rational behavior. Third section presents the experimental evidence about the bargaining power of commitment in this particular payoffs environment. Finally, section four concludes.

2. EXPERIMENTAL DESIGN AND HYPOTHESIS

The experiment was run in May 2009 with economics and management students at the University of Granada, Spain, for a whole sample of 144 subjects. The experiment was fully programmed and conducted using the software Z-Tree (Fischbacher, 1999). The use of computers allows the instructions to be completely presented on each individual screen, and a brief questionnaire was realized to ensure their understanding.

Based on the *hawk-dove game* with perfect information, we recreate a situation where player A can choose between four different reaction rules, whereas player B has only two strategies. It is necessary to clarify that treatments will allow variations in player A`s set of strategies, and in strict terms the normal form *hawk-dove game* was never be carried out because we look for modeling commitment. However, subjects in the experiment always had the matrix, showed in Table 1, as a reference. This because of the simplicity needed to deal with and because it allows for the instructions to be clearer, avoiding explicit references to the game sequence. The payoffs that appear in the matrix are in Euros, not in experimental currency units[2].

Table 1: Hawk-dove game

		P_B	
		B1	B2
P_A	A1	5 , 5	4 , 8
	A2	8 , 4	2 , 2

The possibility of self-committing in a credible way using messages about the own actions is the variable analyzed experimentally. Hence, we have three treatments: One without communication; one where subjects can send messages and commit themselves; and one where subjects can announce their intentions, but messages does not reveal necessarily the action chosen, which means cheap talk. The characteristic of *without messages*, *commitment*, and *non-binding* treatments is summarized in the next section.

2.1 Without messages treatment

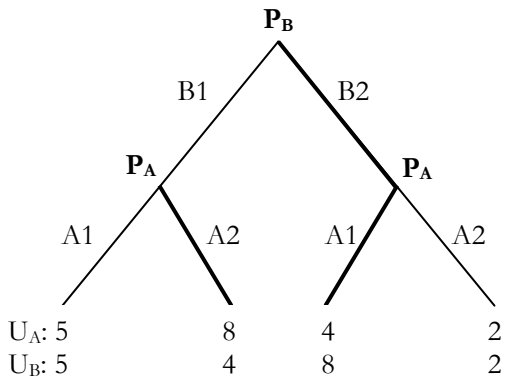
Common to all treatments, there are two types of players; player A and player B. Subjects in the experiment always had the matrix, showed in the table 1, as a reference for the final payoffs calculation. In the first stage, player A's decision consists on choosing a response rule, it is decides between two actions (A1 or A2), for every possible choice of player B. In other words, player A decides: "If player B chooses B1, I choose (A1 or A2) and if he chooses B2, I choose (A1 or A2)". In a second stage, player B must choose between two actions, B1 or B2, without any information about player A's choice.

This scheme gathers the reaction rules, which are an essential element for threats, but removes the decisions sequence. Player A's strategies set is X_A={A1A1, A1A2, A2A1, A2A2} where $x_A=A_{B1}A_{B2}$ represent a possible reaction rule, such that, the first component A_{B1} denotes the action that will be carried out if player B plays B1, and the second component A_{B2} the action in case that B plays B2. Player B's strategies set is X_B={B1, B2}.

[2] We choose this payoff environment because is the simplest negotiation model where there are two equilibria with inequity distribution. The fact of eliminating incentives of mutual cooperation separates it from other games like the prisoner's dilemma or stag hunt, used widely in the experimental literature to study coordination and reciprocity (see Cooper, et al 1992). As observed by Neugebauer et al. (2008), most of the subjects reveal selfish preferences in the *hawk-dove game* and they behave like money maximizers. To reinforce this characteristic, the total payoffs in equitable outcomes are lower than in inequitable ones.

Technically, there is imperfect information because no one knows his opponent's decision at the choosing moment. Although there is no communication and the decisions have been making like simultaneous movements, this structure is the equivalent strategic form of the *hawk-dove game* with perfect information in figure 1.

Figure 1: Hawk-dove game with perfect information



Under the assumption of common knowledge of rationality, the theoretical prediction by backward induction is that player A chooses, according to his incentives, the strategy A2A1, choosing A2 conditioned to B1, and A1 conditioned to B2, because is his best response in each subgame. Player B plays B2, because it is his best response if he forecast the opponent behavior, reaching the outcome (4,8).

2.2 Commitment treatment

In this treatment decisions are the same as in the previous one. In the first stage player A chooses a response rule, and in the second stage player B chooses a single action. The difference now is that player A has the possibility of sending a message to player B, revealing the action he chose. For this reason, if player A sends a message, in the second stage player B face the actual choice of his opponent before taking the decision. If player A decides that "he does not want" to send a message, player B will receive the announcement "there is not a message from player A", and the incentives would be exactly the same as in *without messages treatment*.

The player A possibility of choosing if he want to send a message will be essential for testing if communication is useful to increase his bargaining power. In this sense, now player A has the possibility to play first, committing himself with a reaction rule, and player B knows it. The theoretical prediction is that player A is going to play the strategy A2A2, and he is going to reveal his decision. Here we can label the message A2A2 as a *threat* because it is an aggressive statement, in order to deter the opponent of being aggressive too.

Faced this binding threat, player B's best response is to choose the B1 strategy in order to stay away from the outcome (2,2). In this treatment we find the commitment essential result, where player A changes the unfavorable situation to reach the outcome (8,4), which is his larger available payoff. Player A's bargaining power is reached by threatening his opponent with being a hostile negotiator, taking the risk of falling in the disagreement point.

2.3 Non-binding treatment

In the last treatment, the action set to obtain the payoffs and the game sequence are the same as in the *commitment treatment*. The only change is that if player A wants to send a message, he must choose one, and it is clear for both players that it will not necessarily coincide with the actions that define the final outcome. We intentionally characterize the *non-binding messages* as cheap talk, because they cannot change the payoff structure. In summary, in the first stage player A chooses a response rule. In a second different stage, player A chooses a message, with the same response

rule structure. In the final stage, player B observes the message, if it is possible, and he chooses a single action. Everybody knows that response rules and messages not necessarily coincide and final payoffs are going to be calculated using actions, not messages.

The fact that messages do not modify the game structure implies that player A is going to be indifferent between any of them. The reason is because they are always playing the same extensive game, and by backward induction, there is not an evident advantage in using this type of communication. Now the theoretical prediction is exactly the same as in the *without messages treatment*: player A is going to choose strategy A2A1, and player B chooses strategy B2 independently of receiving a message or not, reaching the outcome (4,8).

The characteristics of *without messages*, *commitment*, and *non-binding* treatments are summarized in Table 2. Note that player B's set of strategies and the set of final outcomes will be constant among treatments, the changes between treatments are player A's set of strategies, including the sending message possibility, and player B's information sets. In *commitment* and *non-binding messages*, the message faced by player B has the same structure, it is: "If you play B1, I will play (A1 or A2); and if you play B2, I will play (A1 or A2)".

Table 2. Timing in the different treatments

Without messages	*Commitment*	*Non-binding*
Player A • Chooses a reaction rule (A1A1, A1A2, A2A1 or A2A2)	Player A • Chooses a reaction rule (A1A1, A1A2, A2A1 or A2A2) • Can player B observe the decision or not?	Player A • Chooses a reaction rule (A1A1, A1A2, A2A1 or A2A2) • Can player B observe the message or not? • Chooses a message (A1A1, A1A2, A2A1 or A2A2)
Player B • Chooses an action (B1 or B2)	Player B • Observes the decision, if is possible • Chooses an action (B1 or B2)	Player B • Observes the message, if is possible • Chooses an action (B1 or B2)
Theoretical Prediction: • Strategy profile: (A2A1, B2) • Payoffs: (4,8) Sample: 30 subjects	Theoretical Prediction: • Strategy profile: (A2A2, B1) • Payoffs: (8,4) Sample: 58 subjects	Theoretical Prediction: • Strategy profile: (A2A1, B2) • Payoffs: (4,8) Sample: 56 subjects

2.4 Game repetitions

Methodologically we assume that players are utility maximizers and their utility function is defined only over their own payoffs.[3] By modeling commitment, this assumption is important because we can highlight the Subgame Perfect Nash Equilibrium for every treatment. This equilibrium concept is based on the assumption that players choose rationally, and this is common knowledge.

The problem of these assumptions is that real people usually are not able to do the reasoning associated with backward induction, or at least not as fast as the theoretical model predicts. For this reason, we conduct a one shot game, plus a surprising restart with 10 period repetitions. It is important to clarify that at the end of each period, participants were completely informed about decisions and payoffs, since repetitions looked forth to increase player's experience about the game.

[3] Though there is a wide discussion about the other regarding preferences, this will not be our focus of analysis, because in essence it would imply changes in the payoffs environment.

The one shot game gives a clear impression of the strategic role of communication, given that the theoretical model does not consider the game is carried out several times. Now, as the possibility of playing repeatedly helps us solving the problem related to the experimental subjects' lack of experience, then the player A or B role is maintained along the whole experiment. In addition, we use absolute typed strangers' protocol, which controls for the reputation effect. It is, the pairs change each period and players never interact with the same partner two times.

Summarizing, comparisons will be between subjects, assigning players' role randomly. Instructions are exactly the same for all participants inside a treatment; in view of the fact that player's type is known when decision-making stage begins. Bearing these considerations in mind, subjects were paid the one shot game payoffs, plus a round period of the following 10, chosen randomly. Average payments were 10 Euros.

2.5 Hypotheses

In our experimental design the payoffs matrix is fixed, for this reason any variation on the outcome reached between treatments must be explained by the availability of messages and their credibility. Based on commitment theory, player A's bargaining power increases if he is able to threat with an aggressive arrangement, but clarifying that this is the unique relevant option. This strategic movement can be implemented if it is possible to send binding messages. For this reason, the experimental design recreate a situation where the possibility to send fully credible messages is available for player A. With this asymmetry in communication, we can expect that player A uses the option of sending the message A2A2 because it is the way of turning the outcome into his favor.

Following this argument, the player A's largest payoffs would be reached in the *commitment* treatment, because the binding messages are available. The theoretical prediction is to reach the (8,4) outcome with *commitment messages*, and the (4,8) otherwise, because *without messages* or *non-binding messages* have the same properties in strategic terms. For this reason, we can compare the average player A's payoffs, and formulate the following hypothesis that captures player A's bargaining power.

- Do people take advantage of commitment opportunity in order to manipulate their opponents' behavior?
  - Hypothesis 1: Player A's payoffs are larger when he can commit himself than when he does not have the option to send messages.
  - Hypothesis 2: Player A's payoffs are larger when he can commit himself than when he can send non-binding messages.

The average total payoff ($U_A + U_B$) will show the importance of the messages to solve the coordination problem, because for both players it is rational to avoid the (2,2) outcome. In the game that we are using in this experiment, total payoffs in equilibrium are 12 Euros independently of the treatment. This variable captures the efficiency of the three different negotiation procedures, and we must expect not significant differences between treatments.

- Is the outcome efficient under the different communication mechanisms?
  - Hypothesis 3: The average total payoff is not different between the without messages and the commitment treatment.
  - Hypothesis 4: The average total payoff is not different between the commitment and the non-binding treatment.

In this section we present the theoretical predictions based on backward induction reasoning in the *hawk-dove game* with perfect information. Although we consider this hypothesis as a good reference point, from a behavioral point of view (Croson, et al. 2003) the learning process is very

important to show how decisions change as experience increases. Based in the usual assumptions of rational choice theory, we must expect that behavior is not time depended.

- Is experience in the bargaining process necessary to implement the threat strategy?
  Hypothesis 5: The final outcome achieved do not change when game repetitions going on.

The last consideration is related with the messages credibility. As we saw before, the commitment is successful if you have the possibility to announce, in a credible way, that you are ready to follow a response rule. The threat has to be public and irrevocable before the opponent plays, since the plan is to change the rival's beliefs, and therefore his decision. In the *non-binding treatment* player A has messages, but he could use it for committing or for bluffing. The theoretical prediction is player A chooses the action A2A1, nevertheless, he can choose a different message in order to induce the opponent to choose B1. This is exactly the purpose of message A2A2.

- Would people lie strategically to turn the agreement into their favor?
  Hypothesis 6: In non-binding treatment, player A chooses the response rule A2A1, but he send the message A2A2.

The Hypothesis 6 must be tested in the direction of Croson, et al.'s (2003) results about the possibility of lying and threatening in the ultimatum game. Their conclusion is that non-binding messages has a clear effect on behavior in two different ways. First, cheap talk can influence the counterpart's decision. This result suggests that negotiators are less crafty than models suggest, but it can be simply related to subjects' inexperience. Second, the deceptive messages have a negative impact on outcomes. This suggests that negotiators respond to cheap talk by changing their behavior and they are ready to punish when they feel cheated, even when punishment is costly for them.

3. RESULTS

This experiment seeks to stand out if messages, credibility and experience are essential to improve player A's bargaining power. To achieve this aim, we are going to analyze first the outcomes in the different treatments and their progression over periods. The empirical evidence shows that, in the one shot game, subjects do not realize the bargaining power of commitment. When the game is repeated and experience increases, subjects gradually understand the advantages of a threat, turning the payoffs into their favor. For this reason, we run a logit model to understand the variables than influence player B to choose B1. In order to simplify the notation we will use the abbreviation of every treatment, which is, *without messages treatment* (WMT), *commitment treatment* (CT) and *non-binding treatment* (NBT).

3.1 One shot game vs. last repetition

Following Crawford (1998), the behavior in the laboratory often takes time to stabilize; then theories that assume equilibrium are usually tested by comparing their predictions to observed behavior in the last period. To control for subjects' unfamiliarity with the environment, we use a simple 2x2 game, providing enough experience via 10 periods repetition to assure meaningful responses and reveal the effects, if any, of learning. The first result compares the outcomes in the One Shot Game (OSG) with the last repetition.

Result 1. There is no evidence in favor of Hypotheses 1 and 2 if the game is played only one time. In contrast, the theoretical argument that supports these Hypotheses is a good predictor of behavior after 10 repetitions. The evidence suggests that it is necessary some experience to implement the threat strategy, differing from Hypothesis 5.

The average player A's payoffs in the OSG were 5.5 Euros in WMT, 5.9 Euros in CT and 5.5 in NBT, as it is shown in Table 3. Although it is possible to see that the highest payments reached

in CT are in the expected direction, differences with respect other treatments are not significant (Mann Whitney test between WMT and CT, p value 0.463; CT and NBT, p value 0.406). With regard to efficiency, the average total payoff is 10.4 Euros in WMT, 11.6 Euros in CT and 10.6 Euros in NBT. Again, the highest payoff obtained in the *commitment treatment* is not significantly different with respect to the other treatments (Mann Whitney test between WMT and CT, p value 0.156; CT and NBT, p value 0.181).

Table 3. Payoffs distribution

	One Shot Game			Last Repetition (Period 10)		
Payoffs	*Without*	*Commitment*	*Non-Binding*	*Without*	*Commitment*	*Non-Binding*
(2,2)	20%	3%	18%	60%	7%	14%
(4,8)	33%	41%	36%	20%	7%	68%
(5,5)	0%	7%	0%	0%	24%	4%
(8,4)	47%	48%	46%	20%	62%	14%
Average	(5.5,4.9)	(5.9,5.7)	(5.5,5.1)	(3.6,3.6)	(6.6,4.4)	(4.3,6.5)

As it is shown in Table 3, the evidence in the last repetition supports Hypotheses 1 and 2 about player's bargaining power. Average player A's payoffs in period 10 were 3.6 Euros in WMT, 6.6 Euros in CT and 4.3 in NBT. Differences of CT respect others treatments are significant at 1% (Mann Whitney test between WMT and CT, p value < 0.001; CT and NBT, p value < 0.001). With regard to efficiency, average total payoff is 7.2 Euros in WMT, 10.9 Euros in CT and 10.7 Euros in NBT. The difference between CT and NB is not significant, but the difference between CT and WMT is significant at 1% (Mann Whitney test between WMT and CT, p value< 0.001; CT and NBT, p value 0.222).

In the OSG differences between treatments are not significant; therefore the evidence does not support Hypotheses 1 and 2. Our conclusion is that played strategies and outcomes neither depend on the possibility of sending messages nor on credibility, if the interaction is carried out only one time. However, in the last repetition the picture is completely different. Clearly, the theoretical prediction is very accurate in CT and NBT, with the outcomes (8,4) and (4,8) being reached in the 62% and 68% respectively. However, it is surprising the great disagreement rate in WMT, because 60% of subjects end up in the (2,2) outcome. In the last period evidence supports Hypotheses 1, 2 and 4, but we must reject Hypothesis 3. Without a doubt the empirical data shows that outcomes and strategies are not time independent. For this reason the following sections look for disentangling the learning process.

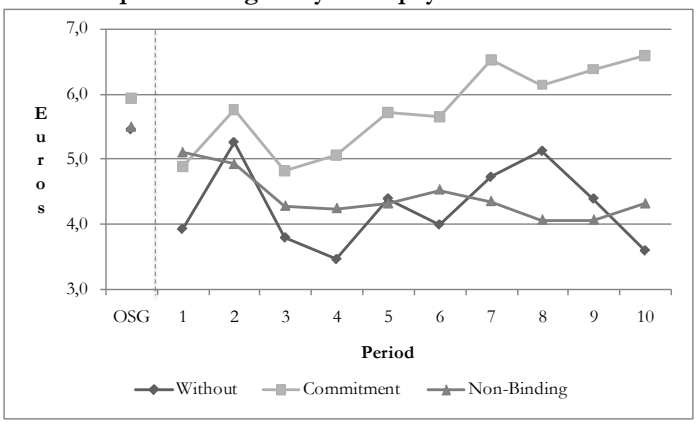
3.2 Outcome progression

As experience increases, in the *commitment treatment* player A turns payoffs into his favor. The question is how does player A reach the higher share of the pie? The answer goes in the direction of the theoretical predictions, threatening in a credible way about falling down into the worst result if his rival does not cooperate. The purpose of the repetitions is to see how the outcomes change when experience increases; therefore the test was performed for the first 5 rounds, and for the periods after the 6th round.

Result 2. As experience increases, commitment improves player A's bargaining power. Player A's payoffs are statistically higher in the *commitment treatment*, as expected in Hypotheses 1 and 2.

When the 10 periods are analyzed, player A's average payoffs are of 4.3 Euros in WMT and 4.4 Euros in NBT, and it is possible to affirm that the trends are completely flat. However, in CT the average player A's payoffs have a positive trend. For the first 5 rounds the average payments are 5.3 Euros, and for the rounds 6 to 10 they raises to 6.3 Euros, as Graph 1 shows. For periods 1 to 10 this difference between treatments is significant at 1% (Mann Whitney test between WMT and CT, p value < 0.001; CT and NBT, p value < 0.001).

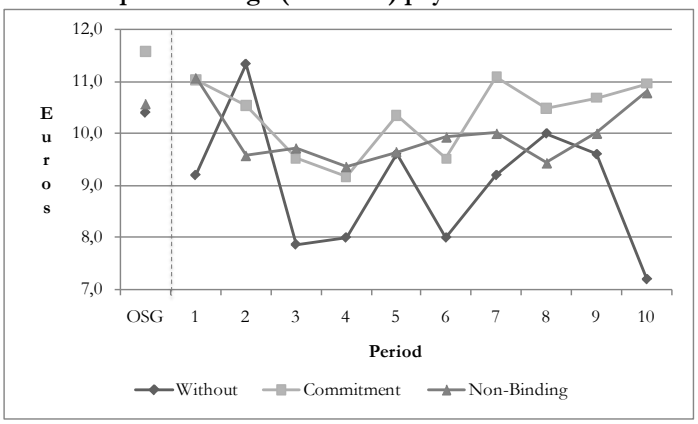
Graph 1. Average Player A's payoffs



Result 3. Sending messages possibility helps solving the coordination problem, with a positive effect on outcomes efficiency. Total payoffs are statistically equal in the *commitment* and *non-binding* treatments, but in the *without messages* this variable is significantly low.

In terms of efficiency, it is possible to conclude that messages help coordination, because total payoffs reached in CT and NBT are higher with regard to WMT. For periods 1 to 5 the average sum of payoffs is 9.2 Euros in WMT, 10.1 Euros in CT and 9.9 Euros in NBT, and this difference is significant for WMT and CT (Mann Whitney test for WMT and CT, p value 0.014; CT and NBT, p value 0.671). As in the previous result, when subjects achieve experience the effect is more salient, for periods 6 to 10 the average payoffs were 8.8 Euros in WMT, 10.6 Euros in CT and 10.0 Euros in NBT (Mann Whitney test between WMT and CT, p value < 0.001; CT and NBT, p value 0.483).

Graph 2. Average (PA + PB) payoffs



In summary, we disentangle experimentally the effect of messages and its credibility to improve player A's bargaining power. Nevertheless, messages can also be used to avoid the outcome (2,2), which is a consequence of the coordination problem inherent to the *hawk-dove game*. It is clear that player A increases his bargaining power in CT, however it is surprising that with experience the outcome in NBT is not only in favor to player B, but it is also his best situation. In addition, the worst condition for both players is the negotiation without communication, because the path is going far from the efficiency frontier[4].

[4] The consequence of imperfect information is the coordination problem. If a player is changing his choice, any of the equilibrium outcomes is selected, and then disagreement point is reached in a proportion higher than in the other treatments. In fact, the negotiation without messages is not a good institution because it implies a high efficiency loss, for this reason it is uncommon to see this lack of communication in a real situation. As in Roth (1985), the disagreement rate is high just as a consequence of coordination among multiple focal points.

3.3 Strategic role of communication

Subjects take advantage of the opportunity to self-commit themselves in order to manipulate their opponent's behavior. We can observe this result in player A's decision to send a message, and also in the strategy chosen by player B.

Result 4: The message is sent in the same proportion in *commitment* and *non-binding* treatments. Notwithstanding, the behavior of those subjects who face the message explains variation between treatments.

For the first 5 periods, there is a significant difference in the proportion of sent messages, given that in CT the proportion is 58% and in NBT it is 74% (p value 0.005). For periods 6 to 10 messages were used in 86% in CT and in 77% in NBT. This difference is significant, but in an opposite direction than in the previous result (p value 0.031). This evidence suggests that decision of sending a message is more difficult in CT at the beginning, but with experience this proportion grows up. In the aggregate when we analyze the 10 periods sample, there are no significant differences in the proportion of sent messages between CT and NBT (p value 0.42), which indicates that messages is considered to be useful independently of their credibility.

For a deeper analysis, we study player B's decision as an indicator of player A's bargaining power of commitment. Table 3 presents the results of four panel logit regressions of player B's decision of play $B1$ including a linear trend (Period), the information about whether player B received a message (message=1) or not (message=0), the time that player B expend to take his decision and treatment dummies as regressors. Regressions 1 and 2 include a dummy for the one shot game, while regressions 3 and 4 include dummies of player B's payoff in $t-1$. Regressions 2 and 4 also include the interaction between period and each one of the dummies of the *commitment* and *non-binding treatments*[5].

Table 4. Regression analysis explaining Player B decision

Player B plays B1	(1)	(2)	(3)	(4)
Message	**1.414*** **	**1.185*** **	**1.874*** **	**1.648*** **
	(0.259)	(0.266)	(0.300)	(0.309)
Period	0.056	0.039	0.039	0.048
	(0.036)	(0.061)	(0.039)	(0.071)
Commitment treatment	0.413	-0.615	0.215	-0.698
	(0.456)	(0.639)	(0.499)	(0.791)
Non-binding treatment	**-1.692*** **	-0.595	**-2.107*** **	-0.781
	(0.482)	(0.664)	(0.536)	(0.823)
Period *Commitment		**0.204*** **		**0.179* **
		(0.076)		(0.093)
Period *Non-binding		**-0.164** **		**-0.194** **
		(0.077)		(0.094)
One shot game	**0.662* **	**0.627* **		
	(0.350)	(0.34)		
$\text{Payoff}_{t-1} = 8$			**-0.680** **	**-0.593** **
			(0.274)	(0.283)
$\text{Payoff}_{t-1} = 5$			0.063	-0.153
			(0.389)	(0.401)
$\text{Payoff}_{t-1} = 4$			-0.101	-0.284
			(0.280)	(0.288)
Choosing time PB	0.009	0.011*	0.009	0.012
	(0.006)	(0.006)	(0.007)	(0.008)
Constant	-1.345***	-1.276**	-1.063**	-1.128*
	(0.429)	(0.5291)	(0.489)	(0.641)
N	792		720	

Panel data estimation with random effects. Standard errors in parentheses.
* p< 0.1, ** p < 0.05, *** p < 0.01

[5] We also estimated logit regressions clustering by individual to computes the correct statistical significance for these interaction terms (Norton et al., 2004). Notwithstanding, the significance of these interaction terms remains under this specification.

Notice that regressions in Table 3 include the variables that influence the probability of choosing $B1$, turning the outcome in favor of player A. The possibility of sending messages is a persuasive strong mechanism, controlling for credibility. The *message* coefficient is always positive, and we can conclude that this effect is significantly robust for explaining the high rates of players A choosing to send messages.

The *commitment messages* have a positive effect, even more if we consider the possibility to learn how it must be used. This effect is captured in the interaction between *period* and *commitment*. Our result could be explained by the fact that the message possibility in CT is the way to inform about the threat A2A2, and player B must choose between the outcomes (8,4) or (2,2). Facing the "never retreat, never surrender" commitment, the rational choice is behave like a dove. Conversely, Table 3 shows a significant negative effect of *non-binding messages*. This result is more salient if we consider that the conditional average proportion of player B choosing B1, given message=1, in this treatment is just 26.8% for 1 to 10 periods. Player A in NBT sent the message because his situation would be even worse if he chose not to do so. The conditional average proportion of players B choosing B1, given message=0, is 18.7%.

If we want to go deep in this analysis it is necessary to understand player B's decision, conditioned to facing a message. In Table 4 we perform a regression analysis only for those players B who faced the message, including dummies of the message sent by player A as regressors. The empirical evidence shows that the threat message A2A2 is not enough to influence the counterpart; player A needs a learning process to understand the strategic role of communication. As we could see above, at the beginning subjects were not using very often the message in CT, but this situation changes when they learn how to use it properly. This fact is captured in the interaction between *period* and *commitment*, with a strong positive effect.

Table 5. Regression analysis explaining Player B decision, conditional to message=1

Player B plays B1	(5)	(6)	(7)	(8)
Message A1A2	**2.942*** **	**2.210** **	**2.058** **	**1.720* **
	(1.005)	(0.940)	(0.996)	(0.986)
Message A2A1	-0.839	-0.798	-1.203	-1.440
	(1.178)	(1.100)	(1.318)	(1.299)
Message A2A2 (Threat)	**2.617*** **	**1.736* **	1.585	1.135
	(0.999)	(0.938)	(0.996)	(0.988)
Period	0.070	**-0.115* **	0.080	-0.096
	(0.054)	(0.069)	(0.059)	(0.078)
Commitment treatment	**2.829*** **	0.272	**3.0940*** **	0.608
	(0.448)	(0.687)	(0.548)	(0.859)
Period* Commitment		**0.436*** **		**0.428*** **
		(0.095)		(0.117)
One shot game	0.737	0.404		
	(0.583)	(0.553)		
$Payoff_{t-1} = 8$			**-0.952** **	**-0.874** **
			(0.406)	(0.427)
$Payoff_{t-1} = 5$			-0.159	-0.577
			(0.609)	(0.645)
$Payoff_{t-1} = 4$			0.006	-0.300
			(0.415)	(0.440)
Choosing Time PB	**0.016* **	**0.018** **	**0.021** **	**0.025** **
	(0.008)	(0.008)	(0.010)	(0.011)
Constant	-4.719***	-2.957**	-3.787***	-2.435*
	(1.181)	(1.164)	(1.267)	(1.306)
N	460		423	

Panel data estimation with random effects. Standard errors in parentheses.
* p< 0.1, ** p < 0.05, *** p < 0.01

Tables 4 and 5 contain variables that suggest an explanation about how learning process works: $Payoff_{t-1}=8$ and choosing time PB. When player B reaches the 8 Euro payoff in a previous period, this fact reduces the probability to play B2 in the current period, compared with reaching the 2 Euro payoffs. In the same way, the variable *choosing time* refers to the seconds spent by

player B in order to take the decision. This coefficient is always positive and conditional to message=1 it is significant. This fact suggest that choosing B2 decision is more cognitive demanding for player B, because it is necessary to spend more time evaluating the consequences.

In summary, with experience player A learns the importance of the threat A2A2 in CT. For periods 1 to 5 this strategy is played by 49.7% of subjects, and it rises to 71% in the last 5 periods. But this message is not the only one to increase player A's bargaining power. Although in a minor proportion (17.2% for 1 to 10 periods), the strategy A1A2 is also used to induce Player's B decision and its effect is positive and significant. This result is particularly interesting because the strategy A1A2 is dominated by A2A1, but can be considered a safety way for obtaining a satisfactory outcome of (5,5) avoiding the conflict about distribution.

In general terms, messages are used in equal proportion independently of their credibility, but individuals' behavior in NBT is completely different. The data allows us to answer the following questions: Are people strategic liars? Are people naive believers of these messages? Is credibility important for commitment?

Result 5. In NBT, messages and actions do not coincide. Player A is choosing those messages, which if believed, influence player B to play B1, but the response rule chosen is the one that the theoretical model predicts. We cannot reject Hypothesis 6.

For the 10 periods the 62.5% of the subjects chose the strategy A2A1. If we restrict the sample to the 75.7% of participants who decided to send a message, we can see that strategy A2A1 was used at 65.7%, but the joint proportion whose chose this strategy and sent the same message is only 4.4%. The result is even more radical for strategy A1A1, where nobody said the truth, as it is shown in the Table 6.

Table 6. Joint proportion between strategies and messages

		Message				
		A1A1	A1A2	A2A1	A2A2	Total
Strategy	A1A1	0,0%	0,9%	1,4%	0,9%	3,2%
	A1A2	0,0%	9,0%	0,0%	1,9%	10,9%
	A2A1	4,7%	36,3%	4,4%	20,4%	65,7%
	A2A2	0,5%	8,0%	2,4%	9,3%	20,2%
	Total	5,2%	54,2%	8,2%	32,4%	100,0%

Message=1 (75.7% of total sample for periods 1 to 10)

The situation is quite different when we analyze the strategies A1A2 and A2A2. The conditional proportion of subjects choosing the message A1A2, given they play the same action is 82.6%. In the same way, 46% of subjects said the truth when they choose A2A2. This fact is even more relevant if we consider that these two messages were played in a large proportion (54,2% and 32,4% respectively) and their effects are positive and significant to explain player B decision, as we can see in regressions 5 and 6 of Table 5.

Nevertheless, the general result in NBT is that players A were lying strategically, but when they chose the strategy A1A2 and A2A2 it was rational to tell the truth, because players B's best response, if they believe the message, is to play B1. The big problem is that a lot of subjects sent these two messages, and just few of them were telling the truth. For players A's bargaining power, results show that neither to lie nor telling the truth is useful in material terms. Commitment seems to influence other player's decision, leading him to choose the strategy B1, but without credibility player A reaches the completely opposite outcome. For periods 1 to 5 the proportion of players B who chose B1 is 30%, and this proportion falls 20% for periods 6 to10, with a strong negative trend.

This result goes in line with the evidence from previous literature (Croson, et al, 2003; Brandts and Charness, 2003), where the willingness to punish an unjust action is triggered by a deceptive message. In our case, a deceptive message inclines player B decision towards strategy B2. Lies destroy the positive reciprocity and lead outcomes to be closer to those that the rational choice theory predicts. In the *hawk-dove game*, to punish is simply to play in an aggressive way, which leads to reaching the Subgame Perfect Nash Equilibrium.

4. CONCLUSIONS

If we want to study in a rigorous way the variables that explain a higher bargaining power in a bilateral negotiation, it is necessary to simplify the situation, specifying clearly the game rules and agents' preferences. This paper shows that in the *hawk-dove game*, a player's bargaining power increase if there is a mechanism to report that he rejects some options, self-committing with a reaction rule that specifies actions that are not best responses. Theoretically these messages face a credibility problem that can make the strategic movement ineffective. In many bargaining models costless messages, unverifiable lies and threats are considered cheap talk, and they do not have an impact on the final outcome. Nevertheless, as we have shown, this type of communication is essential in a negotiation process.

We define three different treatments related with the strategic role of communication, *without*, *commitment* and *non-binding messages*. Each treatment clearly separates the particular effect of messages and credibility on the final outcome. Given that the *hawk-dove* payoffs matrix is fixed between treatments, changes in monetary variables must be explained by the strategies available in each negotiation procedure. In addition, we run 10 repetitions to capture the learning process and the effect where subjects get experience in this environment.

The empirical analysis shows that commitment can improve player A's bargaining power, as it is predicted theoretically. Nevertheless, experience is more important than expected, because it is necessary to threaten the counterpart, and it seems that this decision is not easy to take. A message A2A2 is a threat because it is an aggressive statement, increasing the risk for both, in order to deter the opponent of being aggressive. Credibility is also essential. It is common to find strategic liars, and the rival punishes this behavior.

The center of the analysis in this article has been rational behavior under different tactical alternatives. As it was expected, the *hawk-dove game* is a good environment for selfish behavior, even more if we have in consideration that we use the absolute typed strangers protocol. The advantage of this methodology is that it allows us to have clear theoretical predictions. Nevertheless, a point that has not been highlighted enough is that the result (5,5) is not reached in any of the equilibria that we have studied, and this is interesting because it implies that both players choose to avoid the conflict about outcome distribution. This characteristic opens the possibility of studying commitment with endogenous mechanisms of credibility, taking in consideration different ways to obtain reputation. In the same direction, it is also interesting to extend this procedure to study others payoff environments, as prisoner's dilemma or stag hunt were mutual cooperation could be implemented in equilibrium.

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