Honest Abe or Doc Holliday?
Bluff, Cheap Talk, and Conflict in Bargaining

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Abstract:
We consider a bargaining environment where there is asymmetric information regarding whether the two players have common preferences or conflicting preferences. If the cost of strategic communication is independent of the state, then signaling is not expected to be effective. If the uninformed agent believes a cheap-talk signal, then agents are incentivized to engage in deceptive bluffing. We explore this theoretically and experimentally. We present a bargaining model where state-dependent mixed strategies arise as equilibria. Thus, cheap-talk signaling and bluffing occur in equilibrium. In the model, players who experience a disutility to deceptive behavior are introduced. The set of equilibria are refined and we show, ironically, that the introduction of honest players increases the overall level of deception. We then design an experimental game to assess the validity of the predictions from the theoretical model. We show that agents attempt to strategically transmit information even when (costly) signaling is not possible. Across rounds of the game cheap-talk signaling and bluffing co-move in that as the former becomes more prevalent so too does the latter. Furthermore, we document a contagion effect in the laboratory. Bluffing not only creates deadweight loss in a particular dyad, but leads the agent who was bluffed to engage in more bargaining conflict in future rounds against a new, randomly-selected opponent. Aggregate wealth is higher prior to the introduction of deception in the group.

Keywords: bargaining, bluff, cheap talk, contagion, deception, experiment, signal, strategic information transmission

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1. Introduction

Consider an assistant district attorney whose job it is to process hundreds of criminal cases every year.[1] The prosecutor wants to dispense justice by obtaining appropriate sanctions for the guilty, screen out those not culpable, and clear off as much of the backlog as possible. The vast majority of the cases involve guilty individuals with sufficient evidence to get a conviction at trial. Many are routine cases where reasonable expectations can be formed on what the sentence will be when convicted. In this environment most cases receive a plea bargain which rewards the defendant for saving the prosecutor time, effort, and resources by offering a plea discount. Occasionally, though, a defense attorney may come with a claim that his client is, contrary to the suggestion of the evidence, actually innocent. How does the prosecutor respond? If the attorney is being honest, then it is in both party's interest to dismiss the charges. If it is a bluff, then not only does a criminal go unpunished, but defense attorneys in future cases may be incentivized to bluff as well. Should the prosecutor ignore all such pleas?

While a specific, hypothetical scenario, the dilemma being described arises in numerous bargaining environments. Private information is held by one side to the negotiation. This private information is in regards to whether the scenario is a true adversarial environment of conflicting preferences, or whether it is one of common preferences where both share the same objective. While communication is possible, it is cheap talk in that signals attempted are symmetrically costless. If cheap talk is ignored, then bluffing is ineffectual. Communication breaks down and the uninformed party is left to respond to her ex ante beliefs. Examples of bargaining similar to those described include renegotiations with suppliers due to increased costs when the purchaser cares about the long-run solvency of suppliers (Loch and Wu, 2008), regulation of utilities when regulators care about low consumer prices and costs to energy production (Leaver, 2009), and a real-estate agent encouraging a seller to accept an offer arguing that market demand is weak as opposed to an agent who is bluffing to turn over her inventory and quickly obtain the commission (Levitt and Syverson, 2008).

[1] For example, in a comprehensive survey of all 2330 state-level prosecutor offices in the United States, the average number of closed cases per prosecutor (for offices with at least four prosecutors employed) is 124.3 felonies per year. Thus, the typical assistant district attorney closes approximately 2.5 felony cases each week (see Detotto and McCannon (2015) for a discussion of the data).

Public servants in regulatory positions are often put in the position of bargaining with the regulated in several critical environments. Furthermore, it has been long recognized that market interactions trade-off competition and cooperation, or rather, engage in "co-opetition" (Bradenburger and Nalebuff, 1997). The objective of this study is to appreciate the role and effectiveness of strategic information transmission in these environments.

Whether negotiating in the legal system, regulatory environments, supply chain, or with third-party intermediation, bargaining is both costly and uncertain. We explore both theoretically and experimentally the potential for bluffing and cheap-talk communication. We first develop a simplified bargaining environment where there is asymmetric information regarding whether the parties have common or conflicting preferences and show that state dependent offers are made and accepted. Thus, bluffing and cheap-talk signaling[2] occur in equilibrium with a positive probability. Since with a positive probability the agents have common preferences, an informed player has the incentive to convey this by requesting an outcome that is agreeable to both only if they indeed have common preferences. This, though, encourages bluffing by an agent informed that they have conflicting preferences. Thus, cheap-talk signals encourage bluffing. In equilibrium, cheap-talk signaling is not frequent enough to significant bluffing, but frequent enough to be informative, given the bluffing it incentivizes. The equilibria can be Pareto-ranked and differ in the total number of rejected offers. We then add honest agents, which we refer to as “Honest Abes”, who experience a disutility from misrepresentation and show that this refines the set of equilibria and, ironically, leads to more deception in the negotiations.

We then test the empirical validity of the theory by designing an alternating-offers bargaining game with asymmetric information on the payoff functions. Treatments vary by the costs associated with bargaining conflict and the stakes of the negotiation, both of which are predicted by the theoretical model to affect the frequency of cheap-talk signaling and bluffing. Results from the laboratory experiment conform to the theory. Both cheap-talk signaling and bluffing occur. As cheap-talk signaling increases in frequency in the sessions, bluffing too increases in prevalence. Furthermore, we document a contagion effect of bluffing. Subjects who experience a bluff in a round are more likely to engage in bluffing themselves in the future, increasing conflict and deadweight loss. Comparisons of subjects who

[2] Throughout we refer to the state-contingent play where the informed agent, with knowledge that the true state is one of common preferences, attempts to convey this information through "extreme" actions as cheap-talk signaling. This is to separate it from standard signaling using costly actions, Spence (1973), and pre-play, cheap talk communication, as introduced by Crawford and Sobel (1982). In the presentation of both the theoretical model and experimental method a precise definition for each context, respectively, will be given.

engage in bluffing (the "Doc Hollidays") show that they are qualitatively different individuals from those prone to be Honest Abes.[3]

The only other paper that has theoretically investigated deception in bargaining is Holm (2010).[4] He considers bluffing and truth-telling in a simple, one-shot game. He models a game with conflicting preferences where the receiver has the ability to detect a lie or the truth with a positive probability. There is a related theoretical literature on strategic lying in (costly) signaling environments (Kartik, 2009).[5]

An important related literature is the cheap-talk theory of pre-play communication pioneered by Crawford and Sobel (1983). They illustrate the value of pre-play costless messaging. In their environment communication can be effective when the payoffs of the players are sufficiently similar. A number of important extensions to this environment have been explored, such as "burning money" (Austen-Smith and Banks, 2000; Kartik, 2007) and naïve, credulous receivers of the information (Kartik, Ottaviani, and Squintani, 2007). The important distinction between this environment and ours is that we do not allow for an initial messaging game. Communication in our setting occurs through extreme actions. A counteroffer in a negotiation can be informative if it asks for an amount that would only be agreeable to the uninformed party if the privately held information indicates that it is in both of their interests to agree to the extreme offer (e.g. a request of a case dismissal by a defense attorney).

We are not the first to document intentional deceptive behavior in the laboratory. Brandts and Charness (2003) document experimental evidence that one's willingness to punish an unfair action is sensitive to whether the action was preceded by a deceptive message. Gneezy (2005) provides evidence that individual's willingness to lie depends on the benefits relative to the costs imposed on the deceived, which is further analyzed by Hurkens and Kartik (2007). Charness and Dufwenberg (2006) consider a game where subjects can make non-enforceable promises via communication, but renege on them. While they are cheap talk, promises are made and believed by the subjects. Similarly, Duffy and Feltovich (2006) consider a messaging game where subjects can communicate intended actions and they vary treatments by whether receivers of the message observe whether the subject lied in the past. Wang, Spezio, and Camerer (2010) report data using eyetracking and document that senders do not look

[3] Honest Abe is a nicknamed given to the U.S. President Abraham Lincoln referencing the belief that he could never tell a lie. Doc Holliday was a famous poker player in the Wild West of the U.S. in the late 1800s.
[4] Experimental investigation of truth detection is considered in Holm (2004).
[5] Applications include signaling of platforms by politicians (Callander and Wilkie, 2007; Kartik and McAfee, 2007) and the distortion of criminal evidence (McCannon, 2011).

at the receiver's payoff very often and that their pupils dilate when deceptive signals are sent. Serra-Garcia, van Damme, and Potters (2013) consider deceptive messaging in public goods games and Chen and Houser (2013) consider it in Trust Games. Thus, the experimental research that has been conducted has not focused on bargaining and bluffing through one's action, but through games with deception via untrue messages. Boles, Croson, and Murnigham (2000) and Croson, Boles, and Murnigham (2003) do consider repeated ultimatum bargaining games where resources available are asymmetrically known. Messaging, again, provided the opportunity to deceive. Thus, our distinct contribution is to document bluffing behaviors, rather than deceptive costless messaging and to highlight its diseasing effect in a population.

Section 2 presents the theory. Section 3 describes the experimental methods employed, while Section 4 presents the econometric results. Section 5 concludes.

2. Theory

We proceed by providing a simplified bargaining environment. The objective is to capture the tradeoff that exists between trying to truthfully communicate the state of the world versus deceptively mis-representing the situation. The back-and-forth nature of bargaining is suppressed and the range of possible offers and counteroffers is narrowed to two exogenous levels. These reductions in the environment, though, are done to provide a tractable framework to evaluate the information transmission mechanism.

2.1 Theoretical Framework

Suppose there are two players engaged in a negotiation: Player A and Player B. Player A has made an offer to B of ω, which for the time being will be taken as exogenous. Player B must decide to either accept or reject the offer. Let the probability B chooses to accept the offer be denoted β. If Player B accepts the offer, then the game is over. Alternatively, if Player B rejects the offer, then a counteroffer of Ω is made. Again, the size of the counteroffer is taken as exogenous so that Player B's decision is binary. Furthermore, the rejection of the offer prolongs the conflict and, consequently, costs are incurred by both players. These costs include the direct transaction costs associated with continued negotiations, but also the opportunity costs of lost time that could have been devoted to other enterprises. Let C_i denote the cost to player i of the rejection. Finally, if B makes a counteroffer, Player A makes the decision to accept or reject Ω. Let α denote the probability Player A accepts the offer. If Player A accepts the offer then Ω is the outcome, but if A rejects the offer then the outcome is Z. Thus, the possibility of B rejecting again and countering the counteroffer (and the string of possible back-and-forth negotiations) is suppressed and the expected outcome summarized by the exogenous parameter Z. One may think of Z as the expected outcome, at Player A's decision node, regarding the future alternating-offers behaviors. Furthermore, if Player B accepts Player A's opening offer, then there are no more decisions for A to take. Thus, the selection of α only arises when $\beta < 1$.

Regarding the payoffs, suppose there are two states of the world, $\Sigma = \{n, m\}$, where the state $s = n$ represents conflicting preferences between the two players and $s = m$ indicates common preferences. Let σ denote the (common) prior beliefs regarding the state. Specifically, let $\sigma > ½$ be the probability $s = n$. Regardless of the state, the payoff to Player B is $u_b = X - (1 - \beta)C_b$ where $X \in \{\Omega, \omega, Z\}$. Thus, B wants the agreed upon outcome to be as high as possible, but also suffers a disutility from conflict. For Player A if $s = n$, then $u_a(n) = W - X - (1 - \beta)C_a$ where W is an endowment. Thus, with conflicting preferences, one can think of the negotiation as a mechanism to divide the endowment W between the two players where, X is the division of the pie. Instead, if $s = m$, then the two players have common preferences. In this case, $u_a(m) = W + X - (1 - \beta)C_a$. Hence, with common preferences, both players want X to be as large as possible. Assume $W > \Omega > \omega > Z \geq 0$.

The environment presented is sufficiently general so that it can apply to numerous bargaining environments with asymmetric information. For example, in the criminal justice system, the outcome X can be thought of as the plea discount – the reduction in the sentence obtained by agreeing to plead guilty. The outcome Z captures the expected outcome if the case goes to trial and W is the sanction that arises conditional on conviction (from, for example, sentencing guideline tables). With a small probability the defendant is actually innocent and both parties want to reduce the sentence and, ideally, dismiss the charges ($\Omega = W$). While a very high counteroffer may attempt to signal innocence by the defendant, such an action from a guilty criminal can be thought of as a bluff. In supply-chain renegotiations the outcome X can be thought of as the size of the contract price increase where, with a small probability, the bankruptcy of the supplier harms the final good manufacturer as the switching costs associated with finding a new supplier are high. In this scenario the manufacturer prefers to increase the contract price. Similar mappings can be made to the regulatory or third-party intermediation environments, along with any realistic scenario where there is asymmetric information in bargaining over the validity of conflicting preferences.

2.2 Equilibrium

In the Perfect Bayesian Nash Equilibrium, Player A accepts the offer when $\sigma'[W - \Omega - (1 - \beta)C_a] + (1 - \sigma')[W + \Omega - (1 - \beta)C_a] > \sigma'[W - Z - (1 - \beta)C_a] + (1 - \sigma')[W + Z - (1 - \beta)C_a]$, or rather, $W + (1 - 2\sigma')\Omega - (1 - \beta)C_a > W + (1 - 2\sigma')Z - (1 - \beta)C_a$ where σ' is the updated probability that $s = n$. This simplifies to choosing to accept an offer when $(1 - 2\sigma')\Omega > (1 - 2\sigma')Z$. Thus, the best response for Player A is

$$\alpha = \begin{cases} 0 & if\,\sigma' > \tfrac{1}{2} \\ [0,1] & if\,\sigma' = \tfrac{1}{2} \\ 1 & if\,\sigma' < \tfrac{1}{2} \end{cases} \tag{1}$$

Now consider the decision made by Player B. If Player B accepts the offer, it receives ω. Alternatively, it receives $\alpha\Omega + (1 - \alpha)Z - C_b$ if it rejects. Hence, accepting the initial offer is better when $\alpha < \alpha^*$ where[6]

$$\alpha^* \equiv [\omega - Z + C_b] / (\Omega - Z). \tag{2}$$

Thus, the best response for Player B is

[6] Assume $C_b < \Omega - \omega$ so that $\alpha^* < 1$. If the cost to continue conflict in bargaining is too high, then Player B must accept the initial offer regardless of the decision to be made by Player A.

$$\beta = \begin{cases} 0 & if\alpha > \alpha^* \\ [0,1] & if\alpha = \alpha^* \\ 1 & if\alpha < \alpha^* \end{cases} \tag{3}$$

Therefore, conditioning on σ', (1) and (3) are the best response correspondences.

Finally, consider the beliefs of Player A. If the decision by Player B does not depend on the state of the world, then there will not be a difference in decision making by B. Suppose, then, that Player B's response is determined by the state. Specifically, let β_s denote the probability Player B accepts the initial offer when the state is *s*. If this is indeed the behavior, then Player A's updated probability of the state when the offer is rejected is

$$\sigma' = \sigma(1 - \beta_n) / [\sigma(1 - \beta_n) + (1 - \sigma)(1 - \beta_m)]. \tag{4}$$

The existence of a (non-degenerate) mixed strategy Bayesian Nash Equilibrium requires, from (1), that $\sigma' = ½ = \sigma(1 - \beta_n) / [\sigma(1 - \beta_n) + (1 - \sigma)(1 - \beta_m)]$, which simplifies to $2\sigma(1 - \beta_n) = \sigma(1 - \beta_n) + (1 - \sigma)(1 - \beta_m)$, or rather,

$$\sigma(1 - \beta_n) = (1 - \sigma)(1 - \beta_m). \tag{5}$$

Hence, the set of Perfect Bayesian Nash Equilibria are defined by $\alpha = \alpha^*$, defined in (2), any combination of β_n and β_m which satisfy (5), and beliefs described by (4).

Notice that since $\sigma > ½$, $\beta_n \geq \beta_m$ in all proposed equilibrium (and they are equivalent only when both are equal to one). Furthermore, the lower bound for β_n is $(2\sigma - 1)/\sigma$, such that $\beta_n \in [(2\sigma - 1)/\sigma, 1]$ while $\beta_m \in [0, 1]$. Therefore, a combination of plays for the Player Bs in the two states of the world that satisfy this equality, (5), would lead to $\alpha = \alpha^*$ to be a best response for Player A. As a result, Player B in state *n* would find β_n to be a best response, and Player B in state *m* would find β_m to be a best response.

In this framework, a bluff occurs when Player B rejects the offer demanding a higher offer when they, in fact, have conflicting preferences. Thus, a bluff occurs with probability $\sigma(1 - \beta_n)$. Alternatively, a cheap-talk signal is sent when Player B rejects the offer requesting a higher one, and they have common preferences. This occurs with probability $(1 - \sigma)(1 - \beta_m)$. The two outcomes are equally likely in equilibrium, (5). The set of equilibrium includes $\beta_m = \beta_n = 1$ where all initial offers are accepted and no strategic communication is attempted.[7]

Therefore, bluffing and cheap-talk signaling can occur in equilibrium. It requires that the distortion of the quality of the information caused by bluffing is great enough to make Player A believe it is a 50-50 chance that the rejection comes when there is conflicting vs. common preferences. Conditional on the state of the world, signaling should be more frequently observed than bluffing and, therefore, as a result, total rejections should be greater when the players have common preferences. Also, the equilibrium level of acceptance of counteroffers by Player A, α^*, depends on the size of the opening offer (ω), the cost of Player B's rejection (C_b), and the stakes involved, (Ω - Z and ω - Z).

2.3 Introducing Honest Abes

The previous analysis does not allow for any heterogeneity in the population of potential players, so that, to return to the plea bargaining motivating example, all defense attorneys are the same and have no qualms with misrepresenting and deception. One should be cautious about employing such a pessimistic view of preferences. Also, given that bluffing is destructive in this environment, one might expect outcomes to improve if deceptive individuals are less prevalent. Hence, to extend the framework, suppose there is the possibility of having an Honest Abe as Player B. An Honest Abe experiences a disutility from not telling the truth (i.e., bluffing). Consequently, an Honest Abe's utility function is $u_b(s; H)$ where $u_b(m; H) = X - (1 - \beta)C_b$ and $u_b(n; H) = X - (1 - \beta)(C_b + \theta)$ where $\theta \geq 0$ is the disutility to being dishonest. A similar assumption is employed in Kartik, Ottaviani, and Squintani (2007) and De Haan, Offerman, and Sloof (2015) and experimental evidence is provided by Gneezy (2005).[8] Suppose the likelihood that a Player B is an Honest Abe is η. With probability $1 - \eta$ the player does not

[7] In all other equilibria, Player A's decision node is reached with a positive probability. Thus, out-of-equilibrium beliefs need not be defined. Here, though, the equilibrium utilizes σ' still defined as in (4) for the out-of-equilibrium beliefs. Numerous alternative beliefs could be held that rationalize $\beta_n = \beta_m = 1$ as best responses, but beliefs that result in $\beta_n, \beta_m < 1$ must be those defined in (4) to be Perfect Bayesian Nash equilibria.

[8] Relatedly, Vanberg (2008) provides experimental evidence consistent with subjects experiencing a benefit from keeping their promises (as opposed to a disutility of letting others down).

experience any disutility from being dishonest. We will refer to such a player as a Doc Holliday. A Doc Holliday's utility, $u(s; D)$, remains the same as in the previous section (u_b).

For an Honest Abe, accepting the initial offer is preferable when $\omega \geq \alpha\Omega + (1-\alpha)Z - C_b - \theta$, which simplifies to accepting when $\alpha \leq [\omega - Z + C_b + \theta] / (\Omega - Z) \equiv \alpha^*_n(H)$. Therefore, the best response for an Honest Abe in state $s = n$ is

$$\beta_n(H) = \begin{cases} 0 & if \alpha > \alpha_n^*(H) \\ [0,1] & if \alpha = \alpha_n^*(H) \\ 1 & if \alpha < \alpha_n^*(H) \end{cases} \tag{6}$$

Since no adjustment has been made to the payoff function for Doc Holliday or Honest Abe when $s = m$, (3) continues to be the best response for them. Furthermore, the best response correspondence for Player A, (1), the updating of beliefs (4), and the equilibrium condition (5), all carry over in this extension.

In this extension a mixed strategy, Perfect Bayesian Nash Equilibrium has either Honest Abes playing a non-degenerate mixed strategy, while the Doc Holliday plays a pure strategy of $\beta(D) = 0$ (since $\alpha^*_n(H) > \alpha^*$), or Doc Holliday plays a non-degenerate mixed strategy, while the Honest Abes play the pure strategy $\beta(H) = 0$. Now, in this extension, mixed strategies are both state contingent and type contingent. Therefore, $\beta_s = \eta\beta_s(H) + (1-\eta)\beta_s(D)$ for state s.

The equilibrium condition is the same as before, namely $\sigma(1-\beta_n) = (1-\sigma)(1-\beta_m)$. Thus, there are two sets of equilibria. In one set, $\alpha = \alpha^*_n(H)$. This causes $\beta_n(D) = \beta_m(D) = \beta_m(H) = 0$. Thus, $\beta_n = \eta\beta_n(H)$ and $\beta_m = 0$. Therefore, the equilibrium condition, (5), holds only when $\beta_n = (2\sigma - 1)/\sigma \in (0, 1)$ since $\sigma \in (½, 1)$. Thus, there is only one Perfect Bayesian Nash Equilibrium when $\alpha = \alpha^*_n(H)$; namely $\beta_n(D) = \beta_m(D) = \beta_m(H) = 0$ and $\beta_n(H) = (2\sigma - 1)/\sigma\eta$.

Compare this equilibrium to those which arises if there are no Honest Abes. The equilibrium level of acceptance by Player A is greater. Additionally, the unique equilibrium here is the one with the lowest level of acceptance by Player B when there is no Honest Abes. Thus, bluffing and cheap-talk signaling are maximal. Also, Doc Holliday bluffs and signals with probability 1, whereas without the existence of Honest Abes, this was less than one. Therefore, the entrance of Honest Abes into the subject pool increases cheap-talk signaling and bluffing by Doc Hollidays. The Honest Abes also signal, but also bluff at a higher rate than any equilibrium if Honest Abes did not exist, as illustrated in the previous section. Thus, we get the ironic result that deceptive bargaining escalates when we introduce honest players.

In the second set of equilibria, $\alpha = \alpha^*$. Consequently, $\beta_n(D)$, $\beta_m(D)$, $\beta_m(H) \in [0, 1]$ and $\beta_n(H) = 1$ (since $\alpha^* < \alpha^*_n(H)$) As a result, $\beta_n = \eta(1) + (1 - \eta)\beta_n(D)$ and $\beta_m = \eta\beta_m(H) + (1 - \eta)\beta_m(D)$. Hence, $\sigma[1 - \eta - (1 - \eta)\beta_n(D)] = (1 - \sigma)(1 - \beta_m)$ is the equilibrium condition that defines Player B's selection. The range of possible equilibrium values of $\beta_n(D)$ is $\beta_n(D) \in [((1 - \eta)\sigma - (1 - \sigma))/\sigma(1 - \eta), 1] \supset [(2\sigma - 1)/\sigma, 1]$.[9] The range of possible values of β_m is $\beta_m \in [0, 1]$. Any combination of $\beta_m(D)$ and $\beta_m(H)$ that generates a value of β_m in this interval is an equilibrium.

For these equilibria, the overall rates of acceptances by Player As and Player Bs are unchanged. That is, the equilibrium level of α is the same here as in Section 2.2 and the set of equilibria β_n and β_m are identical in the two models. What does adjust is who engages in strategic information transmission when Honest Abes are added to the population. Consider the comparison in behavior of Doc Holliday with and without Honest Abes in these equilibria. The set of equilibria behaviors in state $s = n$ contains the set without Honest Abes. The mixed strategy which are now equilibria are those with the lower values of $\beta_n(D)$. Thus, Doc Holliday is more likely to bluff when conflicting preferences are present. On the other hand, the set of equilibria is unchanged when $s = m$, so there is no expected difference in cheap-talk signaling behavior. Honest Abes do not bluff.

As stated, there are two sets of equilibria when Honest Abes are present. Overall, the common feature of the two sets of equilibria are that bluffing is (weakly) more likely to arise and cheap-talk signaling is non-decreasing with the introduction of Honest Abes. The unconditional amount of rejections by Player B is unaltered, but the non-Honest Abes will reject offers at a higher rate.

2.4 Welfare and Testable Predictions

We first consider the welfare implications of the equilibria that we have established. With common preferences, welfare is $W + X - (1 - \beta_m)C_a + X - (1 - \beta_m)C_b = W + 2X - (1 - \beta_m)[C_a + C_b]$, while with conflicting preferences welfare is $W - X - (1 - \beta_n)C_a + X - (1 - \beta_n)(C_b + \eta\theta) = W - (1 - \beta_n)[C_a + C_b + \eta\theta]$. Overall, expected welfare is $\sigma[W - (1 - \beta_m)(C_a + C_b + \eta\theta)] + (1 - \sigma)[W + 2EX - (1 - \beta_n)(C_a + C_b)]$, or

[9] If $\eta < (1 - \sigma)/\sigma$, then the lower bound to $\beta_n(D)$ is strictly greater than 0. Otherwise, $\beta_n(D) \in [0, 1]$.

$$W + (1-\sigma)2\mathrm{E}X - (1-\mathrm{E}\beta)(C_a + C_b) - (1-\beta_n)\sigma\eta\theta. \quad (7)$$

where $\mathrm{E}\beta = \sigma\beta_n + (1-\sigma)\beta_m$ and $\mathrm{E}X = \beta_m\omega + (1-\beta_m)(\alpha\Omega + (1-\alpha)Z)$ is the expected agreed upon outcome. This is the welfare for both the base model (setting $\theta = 0$) and the Honest Abe extension. Therefore, expected welfare is greater when exogenous factors adjust, such as when (i) the stakes are greater ($\mathrm{E}X$, or rather, $\Omega - Z$ and $\omega - Z$) and (ii) the costs of conflict are lower (C_a, C_b, and θ). Similarly, expected welfare improves when (iii) the rate of acceptance by Player A is higher (i.e., expected welfare is increasing in α) and (iv) the acceptance by Player B when the two have conflicting preferences is more likely (i.e., expected welfare is increasing in β_n). These are partial effects, though. The impact of adjusting β_m on expected welfare depends on the behavior of Player A, α. If A is sufficiently likely to accept the counteroffer, then accepting the initial offer is counterproductive for both parties. On the other hand, if Player A is unlikely to accept, then both individuals benefit from Player B accepting the opening offer. Thus, for illustration, the expected welfare when $\alpha = \beta_n = 1$ is linear and either strictly increasing or strictly decreasing in β_m so that the optimal is at a corner. Expected welfare with $\beta_m = 1$, $W + (1-\sigma)2\omega$, can be compared to it with $\beta_m = 0$, $W + (1-\sigma)2\Omega - (1-\sigma)(C_a + C_b)$. Therefore, $\beta_m = 1$ is optimal, given $\alpha = \beta_n = 1$, when

$$2(\Omega - \omega) \leq C_a + C_b. \quad (8)$$

The inequality of (8) illustrates that the welfare implications of rejection depends on the total costs caused and the surplus generated. If this inequality holds, then it is optimal for Player B to not engage in cheap-talk signaling when the players have common preferences. If this inequality does not hold, then social welfare is maximized when cheap-talk is always attempted. Hence, when costs are high and the initial offer is sufficiently generous, rejections are suboptimal from a welfare perspective.

While the welfare-maximizing outcome depends on the costs and stakes involved in the negotiation, the set of equilibria in the base model can be Pareto-ranked. Recall that, in equilibrium, (5) must hold and all equilibria share the same value of α, α^*. If we first solve (5) for β_n and insert it, along with α^*, into the expected welfare function, it follows that the expected welfare is strictly decreasing in

β_m. Thus, the equilibrium of the game (in the base model) with $\beta_m = 0$ and $\beta_n = (2\sigma - 1)/\sigma$ Pareto-dominates, while the equilibrium with $\beta_m = \beta_n = 1$ is Pareto-inferior.

Now consider the welfare effects of introducing Honest Abes to the pool of potential players. As shown in Section 2.3 there are two "types" of equilibria that arise. In one, the probability of acceptance by Player A remains the same as in the base model, α^*. Additionally, the set of equilibria β_ms and β_ns remain unchanged. What does adjust is who is engaging in strategic information transmission. In all equilibria in this type $\beta_n(H) = 1$. Thus, there is no bluffing by Honest Abes and, as a consequence, no impact on welfare driven by the disutility of being dishonest. Thus, in this type of equilibria there is no change in welfare by introducing Honest Abes. In the second type of equilibria, Player A's accept the offers at a higher rate. Additionally, the probability of Player B accepting the initial offer is unique and equal to the lowest from the set of equilibria of the first type. Rather, acceptance by Player B in the equilibrium with $\alpha = \alpha^*_n(H)$ is (weakly) less than every equilibria with $\alpha = \alpha^*$. Thus, a tradeoff exists in the welfare calculation between the costs of rejections and the greater earnings when a common preference is the state. Additionally, bluffing is being done by Honest Abes. Thus, welfare is strictly worse when the disutility experienced by Honest Abes is sufficiently great.

Turning to the expectations of play, the following predictions arise from the theoretical model:

[1] Cheap-talk signaling and bluffing occur (β_m and β_n are (weakly) less than one). There exists, though, a range of equilibria which differ in the rates of the two arising.

[2] Conditional on the realization of the state, the frequency of cheap-talk signaling should exceed the frequency of bluffing by a constant factor ($[1 - \beta_m]/[1 - \beta_n] = (1 - \sigma)/\sigma$).

[3] Rejections should be more prevalent when the players have common preferences than when they have conflicting preferences (the set of equilibria β_m contains the set of equilibria β_n).

[4] Higher costs for Player B decrease the total number of rejections (α^* is increasing in C_b while the set of equilibria βs is unchanged).

[5] Higher stakes increase the total number of rejections (α^* is decreasing in Ω and $\Omega - Z$ (both of which capture the stakes) while the set of equilibria βs is unchanged).

While these predictions are based on comparative statics of the model,[10] a test of the accuracy of the theory is relevant. The alternative hypothesis is the intuition that costless communication (without the possibility of messaging as developed by Crawford and Sobel (1983)) should be treated as "babble." Cheap-talk signaling should not be attempted and, consequently bluffing would be unsuccessful. As a further result, rejections should not depend on the costs to conflict and the stakes involved, since opening offers are always accepted.

As a final consideration of the theory, the analysis takes the initial offer by Player A as being exogenous. In a more practical bargaining situation this would not be the case. Consider a stage 0 decision where Player A, uninformed of the state, selects ω. In effect, Player A selects the equilibrium. Notice that the set of βs that exist in equilibrium are not affected by ω, but α^* is. In fact, α^* is increasing in ω. Player A's payoff is, as stated previously, $u_a(n) = W - X - (1 - \beta)C_a$ if $s = n$ and $u_a(m) = W + X - (1 - \beta)C_a$ if $s = m$. Hence, its expected payoff is $\mathrm{E}u_a = W - \sigma \mathrm{E}X + (1 - \sigma)\mathrm{E}X - (1 - \beta)C_a = W - (2\sigma - 1)\mathrm{E}X - (1 - \beta)C_a$ where, again, $\mathrm{E}X = \beta\omega + (1 - \beta)(\alpha\Omega + (1 - \alpha)Z)$ is the expected agreed upon outcome. Since $\mathrm{E}X$ is increasing in ω and $\mathrm{E}u_a$ is decreasing in X, the best response for Player A is to offer $\omega^* = Z$ since the model assumes $\omega \geq Z$.

This assumes that Player B's response to the change in ω is to be unresponsive. While directly, ω does not enter into the derivation of the *bounds* to the set of equilibria, theory is unable to predict which equilibria outcome is chosen. Therefore, it is perfectly reasonable to conjecture that, for example, Player B selects an equilibrium with a higher value of β when ω increases. If, indeed, this occurs then an increase in the initial offer can be advantageous for Player A and non-minimal offers may arise. While not a test of the theory, empirical observations of bargaining can assess the validity of this presumption.

3. Experiment

[10] These predictions are consistent with both the base model of Section 2.1/2.2 and the extension with Honest Abes of Section 2.3.

The theoretical model provides testable outcomes. These predictions are outlined in [1] – [5] in Section 2.4. In a bargaining environment where offers can be either accepted or rejected and countered (at a cost), bluffing and cheap-talk signaling would be expected to arise. A variety of equilibria exist which differ in the likelihood of the strategic information transmission being attempted where deadweight loss (via rejected offers) is greater as more communication is attempted. The costs associated with conflict and the stakes involved are predicted to be important determinants of the rate of bluffing and cheap-talk signaling. We develop a laboratory game to capture these features in order to examine whether these testable predictions can be confirmed. The alternative hypothesis, from a standard cheap-talk argument, would be that communication should be uninformative and, therefore, both not be attempted and not be believed if attempted. First, we describe the methods employed to test these hypotheses.

3.1 Methods

The presentation of the design of the experiment is broken into descriptions of the subjects, design, procedure, and additional assessments.

3.1.1 Subjects

We conducted experiments with undergraduate students at a small, private university in upstate New York. Subjects were recruited from classes within the business school, targeting students in both classes taken by under- and upper-classmen. An online reservation manager was used to recruit and schedule the sessions. A total of 117 subjects participated in the six sessions. Each experimental session lasted approximately one hour and was conducted during several evenings in February and March of 2015. Within each session subjects completed three tasks. After providing informed, signed consent, subjects engaged in the experiment. Second, three assessments were completed. Finally, subjects answered a background information questionnaire.

3.1.2 Game Design

Subjects participated in an asymmetric information, alternating-offers bargaining game. In this game, one subject takes on the role of "Player A", while a second is "Player B." Player A must decide how to divide an endowment, W. Player A makes an offer, X_1, to Player B. Player B has the option to accept the offer, ending the game, or to reject and make a counteroffer, X_2.[11] In this scenario, Player A has the option to accept the request, ending the game, or reject X_2 and counter the counteroffer, X_3. The game continues until one of the players accepts a proposal or J rejections occur.

Regarding payoffs to the game, each rejection costs Player i, C_i. With probability σ the players have conflicting preferences in that the utility to Player A of agreeing to X with R rejections in total ($R < J$) is $u_a(X, R) = W – X – C_aR$. In contrast, Player B receives $u_b(X, R) = X – C_bR$. In other words, with probability σ the bargaining game is one of dividing a pie.[12] If $R = Z$, then $u_a(X, Z) = – C_aZ$ and $u_b(X, J) = – JC_B$. Alternatively, with probability 1 – σ the players have common preferences in that the utility to Player A is $u_a(X, R) = X – C_aR$ and the utility to Player B is, again, $u_b(X, R) = X – C_bR$ (so long as $R < J$). As a result, $Eu_a(X, Z) = σW + (1 – 2σ)X – C_aR$. Since σ > ½, Eu_a is decreasing in X. Only Player B is informed of whether the game is one of conflicting or common preferences, but the informed Player B's utility does not depend on this information. Thus, there is no possibility of the standard, costly signaling of this information.

In the experiment conducted, two of the parameters are manipulated. First, we introduce a high stakes game ($W = 120$) and a low stakes game ($W = 60$).[13] Also, a low cost treatment of $C_a = C_b = 5$, and a high cost treatment $C_a = 5$ and $C_b = 10$ are implemented. The theoretical model predicts that, specifically, the magnitude of the cost to Player B drives equilibrium behavior (Prediction [4]). Thus, our treatments differ in only this cost, maintaining Player A's costs the same throughout. In our experiment we fix the likelihood that subjects have common preferences to 20 percent (σ = 4/5). Thus, four treatments are considered: low stakes – low costs, low stakes – high costs, high stakes – low costs, and high stakes – high costs.[14]

[11] Thus, to connect the experimental design to the theory, $X_1 = ω$ and $X_2 = Ω$.

[12] If $p = 1$, then the game is the classic Rubinstein (1982) alternating-offers bargaining game with the common experimental adjustments of a flat penalty for delay/conflict rather than a proportional penalty (see, for example, Zwick and Chen (1999), Sterbenz and Phillips (2001), and McCannon and Stevens (2015) for examples in experimental economics and management). Furthermore, with σ = 1 and $J = 1$, then the game decomposes into the classic Ultimatum Bargaining Game.

[13] This allows for $Ω - Z$ and $ω - Z$ to be larger to test (5) in the list of predictions from the theoretical model.

[14] In all but the low stakes – asymmetric cost treatment it follows that $J = 6$ (where the endowment would be exhausted in the low stakes – symmetric cost treatment ($J(C_a + C_b) = W$). In the low stakes – asymmetric cost treatment $J = 4$.

3.1.3 Procedure

In all six sessions the subjects completed two rounds of each of the four treatments resulting in a total of eight rounds of play. Subjects assigned to the role of Player A in a round took the role of Player B in the next. In sessions 1, 3, and 5 the subjects played the treatments in the order of low stakes – low costs, low stakes – high costs, high stakes – low costs, and high stakes – high costs, while in sessions 2, 4, and 6 the subjects played high stakes – low costs, high stakes – high costs, low stakes – low costs, and low stakes – high costs, in order.

The sessions were conducted in two rooms. Subjects were randomly assigned to a room. In each round of the game a subject in one room was paired with a subject in the other so that the subjects did not know or see who they were playing with. Numerical IDs were used to preserve confidentiality and promote anonymity. In each round of play subjects were randomly paired so that history and reputation cannot affect play. In sessions with an odd number of subjects, one was selected at random to sit out each round. No player sat out more than one round.

Each session began, after introductions and informed consent, with a description of the game. Printed instructions were distributed and PowerPoint slides were presented to provide the rules. The script used is provided in the appendix. After explanation of the game, subjects were given the opportunity and encouraged to ask questions.

To determine whether the game was one of conflicting or common preferences, the playing cards 10, Jack, Queen, King, and Ace were used. Each individual taking the role of Player B (privately) selected a card (with replacement). Players in both rooms were informed that if the Ace was drawn by Player B in the pairing, then they both receive the amount agreed to, X, minus any penalties from rejections. If another card is drawn by Player B, then B receives X and Player A receives the residual, $W - X$, minus any penalties from rejection. Multiple hypothetical examples were given to make the payoffs and mechanics of the game clear.

The offer made by Player A was written down, collected by the researchers, and posted on a Google Docs spreadsheet, which was visible to subjects in both rooms. Player B observed the offer made by his/her partner and wrote down which card s/he drew along with his/her decision, either to accept the offer or to reject and counteroffer. The decision was posted on the spreadsheet so the partner immediately learned the decision (but not the identity of the card). The decisions bounced back and forth between the two players until an agreement was reached or the maximum rejections occurred. After all groups reached an outcome, Player A was informed whether or not Player B had an Ace before proceeding to the next round. As stated, new pairings were made in each round and the players rotated between the role of A and B.

From this procedure a number of measureable variables arise. For a pairing with individual *i* in the role of Player A and individual *j* in the role of Player B, $Rejections_{ij}$ measures the number of rejected offers that occurred. $Rejections_{ij}$ captures the amount of conflict, or rather the deadweight loss, which arose. Predictions [3], [4], and [5] from the theoretical model all make statements in regard to the number of rejections. Also, the number of rejections is a main determinant of welfare. Specifically, the equilibria in the model can be Pareto ranked and the ranking is ordered by the number of rejected offers. Furthermore, the analysis considers the opening offer made by Player A, normalized by the size of the endowment, $Open_i$. An indicator variable $Reject_j$ is set equal to one if Player B rejects A's opening offer. Thus, $Open_i$ and $Reject_j$ are the initial decisions of the players (ω and β in the theoretical model). Furthermore, to capture strategic information transmission the variable $Bluff_{ij}$ equals one if and only if Player B did not draw an Ace, rejected the opening offer of Player A ($Reject_j = 1$), and countered with an offer strictly greater than three-fourths of the endowment (either greater than 40 when $W = 60$ or greater than 90 when $W = 120$). Similarly, the variable $Signal_{ij}$ equals one if and only if Player B drew an Ace, rejected the opening offer of Player A ($Reject_j = 1$), and countered with a request strictly greater than three-fourths of the endowment.

Finally, before the first round of play, subjects were informed that they would be financially compensated. Specifically, they were informed that a minimum payment of $10 would be earned, as a guaranteed profit for participating. They were also told that they could earn more as they played the games, but how much they earned depended on their decisions, choices made by others, and luck. One round of the game was selected at random and the subjects were informed that the number of points earned in that round would be converted into real dollars at the exchange rate of 2 points = $1.

3.1.4 Assessments

The second component of each experimental session was the completion of two assessments. They are common evaluation tools used to assess preferences for decision making under uncertainty.

First, to gauge subject's risk preferences, the tool developed by Holt and Laury (2002) was given. Specifically, the exact same set of choices and payoffs as used in Deck, Lee, Reyes, and Rosen (2012) and McCannon, Tokar Asaad, and Wilson (2015) was administered. In the risk assessment, subjects made ten separate choices. For each choice two lotteries were presented and the subject selected the one he or she preferred. The first option was for a relatively safer gamble where either 10 or 8 points could be earned. The second option was for a riskier lottery receiving either 19.25 or 0.50 points. The ten choices differed in the probability of obtaining the higher of the two outcomes. A random number generator selected an integer between one and ten to determine which outcome arose. Table 1 presents the risk assessment used.

TABLE 1: Risk Assessment

	Option (a)		**Option (b)**	
Choice 1	10	if X	19.25	if X
	8	if 1, 2, 3, 4, 5, 6, 7, 8, 9, 10	0.50	if 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
Choice 2	10	if 1	19.25	if 1
	8	if 2, 3, 4, 5, 6, 7, 8, 9, 10	0.50	if 2, 3, 4, 5, 6, 7, 8, 9, 10
Choice 3	10	if 1, 2	19.25	if 1, 2
	8	if 3, 4, 5, 6, 7, 8, 9, 10	0.50	if 3, 4, 5, 6, 7, 8, 9, 10
Choice 4	10	if 1, 2, 3	19.25	if 1, 2, 3
	8	if 4, 5, 6, 7, 8, 9, 10	0.50	if 4, 5, 6, 7, 8, 9, 10
Choice 5	10	if 1, 2, 3, 4	19.25	if 1, 2, 3, 4
	8	if 5, 6, 7, 8, 9, 10	0.50	if 5, 6, 7, 8, 9, 10
Choice 6	10	if 1, 2, 3, 4, 5	19.25	if 1, 2, 3, 4, 5
	8	if 6, 7, 8, 9, 10	0.50	if 5, 6, 7, 8, 9, 10
Choice 7	10	if 1, 2, 3, 4, 5, 6	19.25	if 1, 2, 3, 4, 5, 6
	8	if 7, 8, 9, 10	$0.50	if 7, 8, 9, 10
Choice 8	10	if 1, 2, 3, 4, 5, 6, 7	19.25	if 1, 2, 3, 4, 5, 6, 7
	8	if 8, 9, 10	0.50	if 8, 9, 10
Choice 9	10	if 1, 2, 3, 4, 5, 6, 7, 8	19.25	if 1, 2, 3, 4, 5, 6, 7, 8
	8	if 9, 10	0.50	if 9, 10
Choice 10	10	if 1, 2, 3, 4, 5, 6, 7, 8, 9	19.25	if 1, 2, 3, 4, 5, 6, 7, 8, 9
	8	if 10	0.50	if 10

Thus, a risk neutral individual would select option (a) for the first five choices and option (b) for the last five. A risk averse individual will select (a) for more than five choices and the more risk averse an individual is the more times (a) will be selected. Alternatively, a risk loving subject will select option (a) fewer than five times. We define $Safe_i$ as the number of times option (a) is selected by the subject.[15] Consequently, as used in previous research on decision making under uncertainty (Deck, Lee, Reyes, and Rosen, 2012; McCannon, Tokar Asaad, and Wilson, 2015), $Safe_i$ is used to measure the degree to which a subject is risk averse in the experiment.[16]

Second, an ambiguity assessment was administered. Specifically, the design created by Halevy (2007) is utilized. In the analysis each subject is confronted with an envelope. Within the envelope is ten playing cards, which are red and black. One card from the envelope is drawn. Each subject must first guess which color is selected. If the card pulled is the same color as he or she guessed, then s/he earns twenty additional points. If the subject guesses incorrectly, s/he receives zero. Before realizing the accuracy of his or her guess, each subject is given the opportunity to sell back the gamble. Each subject selects a number between zero and twenty. The number represents his or her reservation price – the lowest price s/he is willing to accept instead of taking the gamble that s/he correctly guessed the color. A number between zero and twenty is selected at random and if the number selected exceeds the reservation price chosen by the subject, then the subject receives the randomly selected amount rather than experience the lottery. If the randomly selected number is less than the reservation price chosen, then the subject is left with the gamble.

Two envelopes were used and each subject, consequently, made two guesses and chose two reservation prices. In the first envelope, five red and five black cards were inserted. The experimental subjects were informed of this distribution. In the second envelope, the subjects were told there were ten red and black cards in total, but they were not told how many of each color were in the envelope. They knew, though, that there were a total of ten cards in the envelope.

[15] Choice 1 is included to have a ten question instrument but, also, to identify unreliable decision making. In no circumstance did a subject choose (b) for Choice 1.

[16] One can be concerned about the behavior of a subject without "standard" risk preferences, since in expected utility theory, regardless of the type of risk preference a person has, a switching point in the decision problem arises. A small portion of the sample switched between (a) and (b) more than once. An indicator variable capturing these subjects can be included in the specification. The results presented in the next section are robust to its inclusion.

The reservation price selected with Envelope 1 measures risk preferences. A risk neutral individual would be indifferent between a lottery of 0 or 20 with equal probability or receiving 10 with certainty. A selection less than 10 represents a risk averse individual, while a selection greater captures a risk loving individual. Envelope 2 captures ambiguity preferences (Ellsberg, 1961). For a fixed choice for Envelope 1, a decrease in the reservation price for envelope 2 represents an individual who is more averse to ambiguous choices. Table 2 summarizes the assessment.

TABLE 2: Risk & Ambiguity Assessment

	Known Information:	**Used to Assess…**
Envelope 1	10 cards – 5 red and 5 black	risk preference
Envelope 2	10 cards – red and black (unknown distribution)	ambiguity preference

Along with a full explanation of the two assessments with numerous examples and an opportunity to ask questions, subjects were informed that they would be financially compensated for their selections. One of the choices in these two assessments was selected at random and the subject would be compensated based on the outcome of that choice. Specifically, they were informed that a random number generator would be used to determine which choice would receive financial compensation. The total monetary gains of a subject in the experiment is comprised of the amount earned in a randomly selected round from the game and the choice between the lotteries made in the randomly-selected decision problem. As stated, a minimum wage was imposed for each subject in each session where we guaranteed that $10 would be earned. Thus, subjects earned between $10 and $34 in the experiment, with a mean payout of $21.54.

Finally, at the end of each session, subjects completed a background questionnaire. Basic information was collected. Specifically, their gender, year in school, major, and state of residence was collected. Also, a survey question evaluating their comfort with bargaining was administered. Subjects were asked, on a -2 to +2 Likert scale, to "[r]ate the extent to which you dread versus look forward to negotiating, bargaining, and haggling." The number selected becomes the variable $Dread_i$. Table 3 provides variable definitions and descriptive statistics for the background and assessed characteristics of the subjects used in the analysis.

TABLE 3: Subject Information
(N = 117)

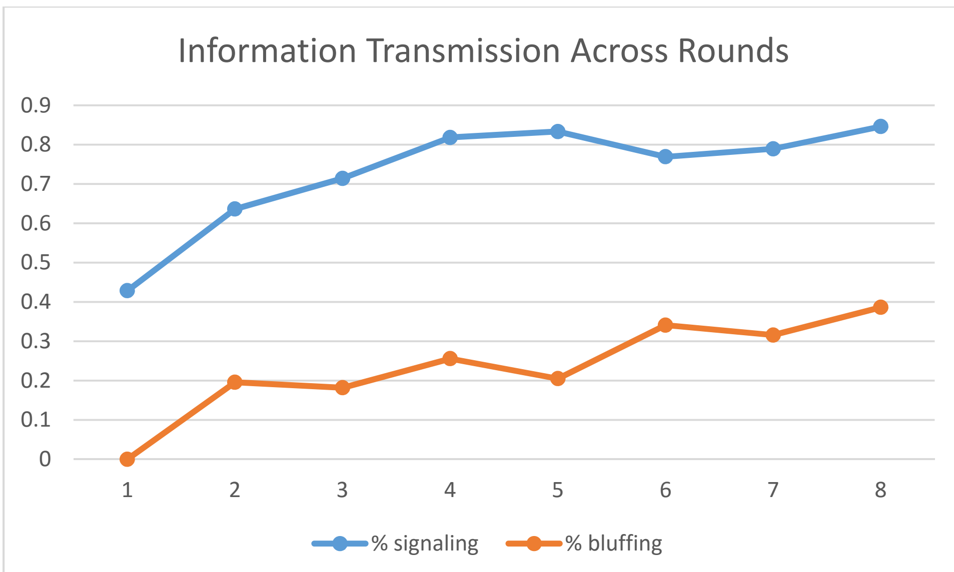
Variable	Description	Mean
Background Information		
Male	= 1 if the subject is a woman	0.594
Foreign	= 1 if the subject is not from the U.S.	0.068
NY	= 1 if the subject is from New York state	0.641
Business	= 1 if the subject is a business major	0.761
Dread	dread -2, dislike -1, neutral 0, like +1, look forward to +2	0.460
Assessments		
Safe	number of safe selections (out of 10) in the risk assessment	5.840
E1	reservation price selected with envelope 1	10.06
E2	reservation price selected with envelope 2	9.120

The sample is disproportionately men from New York majoring in business, which is due primarily to the recruitment strategy used. Subjects also report a slight preference for bargaining. While the sample average registers risk aversion ($Safe_i > 5$) and ambiguity aversion ($E2 < E1$), the median individual is risk neutral and ambiguity neutral. As to be expected, the correlation between *Safe* and *E1*, along with the correlation between an indicator variable equal to one if *Safe* > 5 and an indicator variable equal to one if *E1* < 10, is positive and statistically significant.

3.2 Preliminary Findings

Initial findings from the laboratory experiment conform to the theoretical model. Consider, first, the prevalence of bluffing and cheap-talk signaling. In the observed data, as stated, we register a counteroffer as being a bluff if (i) a card other than the Ace was drawn by the subject in the role of Player B and (ii) a counteroffer of strictly more than three-fourths of the endowment is made. We record a counteroffer as being a signal if (i) is replaced with its converse (i’) an Ace was drawn by the subject in the role of Player B. We feel that the cutoff value use for differentiating bluffs and cheap-talk signals ($X_2 > 0.75W$) is satisfactory. Of the set of recorded bluffs and cheap-talk signals, 80.6% of them have a counteroffer request of all of the endowment ($X_2 = W$).[17] Only 1.5% of the observations in the data set make counteroffers between 80% and 90% of the endowment. Figure 1 depicts the rates of bluffing and signaling across the rounds of play.

Figure 1: Information Transmission Across Rounds



While initially low, the rate of bluffing grows substantially over the rounds. By the second round only 20% of the pairings without an Ace see a bluff and the proportion grows to nearly 40% by the final round. Similarly, signaling becomes more prevalent. The proportional change, though, is more modest. Furthermore, the results are consistent with the theoretical model in that the rates of cheap-talk

[17] There is not a clear pattern to be discerned from the bluffing and cheap-talk signaling via the size of the counteroffer. Of the counteroffers requesting 100% of the endowment, 45.7% where bluffs and 504.3% were cheap-talk signals. Thus, subjects would not be able to (accurately) infer the state from the size of the counteroffer. Given that in equilibrium the unconditional frequency of bluffs and cheap-talk signals should be equal (50% for each), this is again quite close to the equilibrium condition. For the set of all counteroffers with $X_2 > 0.75W$, the proportion that is cheap-talk signals and bluffs is even closer, 50.6% and 49.4%, respectively.

signaling and bluffing should co-move in that higher rates of cheap-talk signaling should encourage higher rates of bluffing. Therefore, hypothesis [1] receives strong empirical support.

In fact, the relative rate of the two actions conform strikingly well to theory. Equation (5) in Section 2.2 provides the equilibrium condition that describes all theorized outcomes in the game (both with and without Honest Abes). The (conditional) rate of signaling, $1 - \beta_m$, relative to the (conditional) rate of bluffing, $1 - \beta_n$, should equal $\sigma/(1 - \sigma)$; the relative probability of observing the two states of the world. Recall that in the experimental design the probability of common preference is $\sigma = 0.8$. Hence, theory predicts that cheap-talk signaling should be more prevalent than bluffing and, specifically, it should be observed four times as frequently, [2]. Dropping the final round, due to the potential effects of play at the end of a finite game, bluffing occurs 21.6% of the time and cheap-talk signaling occurs at a rate of 72.0%, which is over 3.3 times as great. Furthermore, the unconditional rates of cheap-talk signaling and bluffing should be equal. For all observations with either type of strategic information transmission attempted (those with $X_2 > 0.75W$), the proportion that is cheap-talk signals and bluffs is quite close, 50.6% and 49.4%, respectively. Therefore, bluffing and cheap-talk signaling behavior coincide with the theoretical model.

Figure 1 suggests that the subjects in the experimental sessions shifted equilibria. Initially, an equilibrium with low levels of information transmission are played. As bluffing is introduced into the group, the subjects gravitated toward play with both more bluffing and more cheap-talk signaling.

While Figure 1 illustrates that bluffing and cheap-talk signaling occur in the experimental sessions, Figure 2 investigates a contagion effect in the laboratory. For each session the first bluff (or bluffs if there is more than one in the round that bluffing first occurs) that arises in that session is identified. The average number of rejections per dyad, prior to the first bluff, can be compared to the average number of rejections in the rounds following the initial bluff round. The data for each session is centered around period 0 – the round with the first bluff - and behavior one and two periods prior (denoted -1 and -2) is compared with behavior one and two periods after (denoted +1 and +2, respectively).

Figure 2: Average Number of Rejections in a Dyad before and After the First Bluff

The figure illustrates the destructiveness of the first bluff in a group. Prior to the first bluff, the number of rejections observed is quite low. The average number of rejections over -1 and -2 periods prior to the first bluff is less than 0.9. The average number of rejections in the rounds +1 and +2 exceeds 1.5. This is a 72% increase in the number of rejected offers. This suggests that bluffing creates a contagion that increases deadweight loss.

Table 4 presents a description of the results from the experiment. Along with full sample results of the outcomes in play, the sample is subdivided by the treatments considered and the (exogenous) state realized.

TABLE 4: Results from the Experiment

	# of Rejections	Rate of Failure	Agreed Split	Wealth A	B
Full Sample	1.20	6.8%	61.7%	44.1%	51.3%
Low Stakes	0.98	4.8%	62.0%	43.3%	50.3%
High Stakes	1.42	8.9%	61.4%	44.9%	52.2%
Low Costs	1.16	6.2%	60.1%	42.4%	52.8%
High Costs	1.24	7.5%	63.2%	45.7%	49.7%
Conflicting Preferences	0.94	4.8%	56.6%	38.1%	48.8%
Common Preferences	1.93	12.5%	75.7%	60.6%	58.1%

While the number of rejections exceeds one, on average, the standard deviation on the number of rejections per dyad is high (1.7). In fact, 49.9% of the pairings experienced no rejections, while almost 7% experienced full bargaining failure in that the maximum number of rejections arose. Consistent with Figure 1 (and the prediction [3] from the theoretical model), rejections were much more prevalent when the subjects had common preferences. Also, interestingly, rejections were much higher in the high stakes treatments. Again, this is consistent with the predictions from the theory, [5]. There is little difference, though, between the high cost and low cost treatments, [4]. The differences in rejected offers are mirrored when looking at whether the bargaining failed.

Regarding the agreed upon split of the endowment, Player B's in the experiment averaged a gain of over three-fifths of the pie. This was exaggerated when the parties had common preferences. Consistently across the treatments, Player As earned a lower percentage of the endowment in wealth than Player Bs. Presumably, this is due to the ability of the informed Player B to bluff.

4. Results

To formally investigate the consequences of strategic information transmission the pooled data set can be considered. Section 4.1 examines the results of a regression analysis of bargaining decisions throughout the experiment. Additionally, the predictions of the theoretical model are tested and the contagion effect is explored. Section 4.2 searches for the Honest Abes in the sample and examines their impact on bluffs and welfare.

4.1 Econometric Results

To test the role of strategic communication on conflict, the number of rejections ($Rejections_{ij}$) is used as the dependent variable. This is the important variable to appreciate as it captures the direct deadweight loss due to conflict and bargaining and that the comparative statics of the theoretical model predict that the treatments (and realized state) directly affect this number. Controls for the treatment (*High Stakes* equals one if and only if $W = 120$ and *High Cost* = 1 if and only if $C_b = 10$) and session fixed effects are, therefore, included as explanatory variables. Also, measurements for the size of the opening offer ($Open_{ij}$) and the state of the world (*Ace* equals one if and only if the card randomly selected by Player B was an Ace) are incorporated. If bluffing and cheap-talk signaling cause additional conflict, then their measured marginal impact on the number of rejections should exceed one (since the act of bluffing and cheap-talk signaling requires that the opening offer is rejected). Table 5 presents the econometric results with standard errors clustered by round of play.

TABLE 5: Results - Bluffing
(N = 454)

dep. var. =	*Rejections* I	II	*Offer* III	*Reject* IV
High Stakes	0.379 ** (0.155)	0.414 *** (0.134)	0.005 (0.014)	0.444 ** (0.216) [0.111]
High Costs	-0.211 *** (0.063)	-0.193 *** (0.066)	-0.003 (0.009)	-0.136 (0.259) [-0.034]
Ace	0.285 ** (0.138)	1.618 *** (0.113)		2.068 *** (0.257) [0.451]
Offer	-2.055 *** (0.470)	-2.462 *** (0.538)		-7.545 *** (1.731) [-1.886]
Bluff	2.388 *** (0.209)	2.332 *** (0.189)		
Signal	2.233 *** (0.286)			
Pre-Bluff	-0.146 * (0.088)		-0.021 ** (0.009)	
Signal x *Post-Bluff*	-0.377 (0.484)			
Bluffed 1		0.181 *** (0.045)		0.571 ** (0.243) [0.140]
Bluffed 2			-0.039 *** (0.017)	
Bluffor 1		0.458 * (0.256)	-0.048 ** (0.016)	
Bluffor 2				0.171 (0.139) [0.043]

Session Controls?	YES	YES	YES	YES
adj R^2	0.485	0.411	0.070	0.220
AIC	1482.3	1542.0	-496.8	514.9

Standard errors clustered by round of play.
*** 1%; ** 5%; * 10%

Column I illustrates the breakdown in well-being when the trust in 'Honest Abes' succumbs to the bluffing of the 'Doc Hollidays'. Bluffing and signaling are both destructive activities. Attempting either generates more than two rejections. Given that each rejection reduces 8.3% to 25% of the surplus[18], the destruction of attempted communication is substantial.

The rounds prior to the first bluff enjoy less conflict than rounds after. This is captured by the indicator variable *Pre-Bluff*, which is equal to one if and only if the observation occurred in a round prior to the first bluff arising in that session. The negative and statistically significant coefficient for *Pre-Bluff* suggests that bluffing spills over into the cooperativeness of the entire session. Given the mean value of *Rejections* from Table 4, being in a pre-bluff round decreases rejections by 13.9%. The statistically-insignificant coefficient on the interaction term, *Signal* x *Post-Bluff*, suggests that the effect of the introduction of bluffing does not impact the success of cheap-talk signaling.

As expected, the exogenous variation in the environment is correlated with bargaining conflict. Rejections are higher in high stakes situations than low stakes ones. Similarly, enhanced costs to conflict on behalf of the recipient of the initial offer is correlated with reduced rejections. Also, the size of the opening offer is correlated with conflict. More generous offers are, as one would expect, accepted. All of these effects were predictions of the theoretical model.

What the first column in Table 4 does not provide, though, is an explanation of the mechanism in which conflict permeates within a group. Multiple potential channels exist. One possibility is that bluffing is idiosyncratic. Once an individual adopts it as a tactic to extract more of the surplus in bargaining, overall conflict in future interactions will increase simply because that individual continues to employ the tactic. Rather, a Doc Holliday continues to bluff, which generates conflict. A second possibility is disease. An otherwise Honest Abe is exposed to the destructiveness of the addition of noise to the cheap-talk signals received. This infects the individual, turning them into a Doc Holliday who will bluff other individuals in future interactions.

The second column includes lagged effects. *Bluffed 1* is an indicator variable equal to one if the subject was subjected to a bluff in the previous round. The variable *Bluffor 1* is equal to one if the

[18] Since $C_a + C_b$ equal either 10 or 15 and the endowment is either 60 or 120, each rejection destroys either 8.3%, 12.5%, 16.7%, or 25% of the surplus.

subject was the one who bluffed in the previous round. Both variables have positive and statistically significant coefficients. At the mean, an individual who experiences a bluff will experience a 15.6% increase in the number of rejections in the next interaction. Similarly, at the mean, an individual who bluffs in a round will experience 37.4% more rejections in the following negotiation.

The observation that both lagged variables are positive and statistically significant indicates that both hypotheses are occurring. Doc Hollidays continue to have conflict in future rounds, reducing welfare. They also infect others. Their partner is more likely to reject the opening offer in the next round.

The third column explores the cooperativeness of the individuals by considering their opening offer. An individual who bluffs in a round makes the opening offer in the next round. An individual who experiences a bluff in a round does not make another opening offer for two rounds. Thus, *Bluffed 2* captures the effect of being the victim of a bluff the next time that person takes the role of Player A in the game.

Both the coefficient on *Bluffed 2* and *Bluffor 1* are negative and statistically significant. The individual who bluffs in a round tends to make a less generous opening offer in the next round. At the mean value of *Offer*, the bluffor makes an offer that is 8.2% smaller. The individual who experiences the bluff makes an opening offer that is 9.7% smaller.

The negative and statistically significant coefficient on *Pre-Bluff* indicates another spillover effect of bluffing. In the interactions prior to the first bluff, opening offers are less. Once bluffing commences, the first-movers increase their opening offer, presumably in an attempt to reduce the level of destruction. Thus, there is a contagion effect.

Finally, the fifth column presents the results of a logit estimation with the binary variable *Reject* as the dependent variable. Logit coefficients are presented, while the standard errors clustered by round of play are given in the parentheses and the marginal effects are presented in the brackets.

The positive and statistically significant coefficient on *Bluffed 1* indicates that those who are subject to a bluff are more likely to reject an offer in the next negotiation, even controlling for the presence of the Ace and the size of the opening offer. Again, this is evidence of the disease from playing with Doc Hollidays. The magnitude of the effect is substantial, increasing the likelihood of rejection by approximately 12 percentage points.

While the previous analysis focuses on impact of bluffing behavior. A complementary analysis can be done on the impact of cheap-talk signaling. As with bluffing, intertemporal variables can be created. The individual who received a cheap-talk signal, while in the role of Player A, takes a value of one for *Signaled 1* in the next period and *Signaled 2* in the period after that. The subject who made the cheap-talk signal, while in the role of Player B, takes values of one for *Signalor 1* and *Signalor 2* in the next two rounds. Table 6 presents the results.

TABLE 6: Additional Results - Signaling
(N = 454)

dep. var. =	*Rejections* I	*Offer* II	*Reject* III	IV
High Stakes	0.378 ***	0.006	0.482 **	0.482 **
	(0.141)	(0.014)	(0.220) [0.120]	(0.229) [0.120]
Asymmetric	-0.189 ***	-0.006	-0.114	-0.191
	(0.061)	(0.010)	(0.250) [-0.029]	(0.217) [-0.048]
Ace	0.253 *		2.073 ***	2.103 ***
	(0.142)		(0.275) [0.452]	(0.269) [0.457]
Offer	-2.008 ***		-7.501 ***	-7.616 ***
	(0.473)		(1.822) [-1.875]	(1.810) [-1.904]
Bluff	2.430 ***			
	(0.216)			
Signal	1.992 ***			
	(0.208)			
Bluffed 1				0.593 **
				(0.261) [0.145]
Bluffor 2				0.199
				(0.125) [0.050]
Signaled 1	0.002		0.283	0.376 *
	(0.196)		(0.212) [0.070]	(0.222) [0.093]
Signaled 2		0.028		
		(0.027)		
Signalor 1	-0.098	0.009		
	(0.142)	(0.027)		

Signalor 2			0.426 **	0.370 **
			(0.181) [0.105]	(0.188) [0.091]
Session Controls?	YES	YES	YES	YES
adj R^2	0.483	0.058	0.218	0.224
AIC	1483.6	-492.1	515.9	516.2
% correct			72.0%	72.9%

Standard errors clustered by round of play.
*** 1%; ** 5%; * 10%

The results in Table 6 reveal that cheap-talk signaling does not have the same degree of contagion effects as does bluffing. While the act of either signaling or bluffing increases the number of rejections, there is not a future effect on behavior. Those who signal in a round are not more or less likely to experience conflict while bargaining in the future. Similarly, those exposed to cheap-talk signals do not see changes in deadweight loss in future periods. The third and fourth columns present some evidence that the subjects who signal in a round are more likely to reject an offer in the future.

Rather than focus on conflict in bargaining, the contagion effect can be evaluated based on whether they encourage others to signal or bluff in future interactions. Table 7 presents results with the indicator variables *Bluff* and *Signal* as the dependent variables.

TABLE 7: Explaining Information Transmission
(Subsample Comparisons)

	Bluff		*Signal*	
	I	II	III	IV
High Stakes	0.339	0.423 **	0.678 *	0.654 **
	(0.208)	(0.191)	(0.364)	(0.286)
	[0.057]	[0.072]	[0.122]	[0.1080]
Asymmetric	0.470	0.399	0.469	0.344
	(0.472)	(0.407)	(0.685)	(0.576)
	[0.080]	[0.068]	[0.087]	[0.059]
Offer	-1.745 **	-1.734 **	-6.781 ***	-6.498 ***
	(0.889)	(0.811)	(0.773)	(1.219)
	[-0.295]	[-0.295]	[-1.247]	[-1.105]

Bluffed 1	0.092	0.137	0.620	0.853
	(0.248)	(0.406)	(0.694)	(0.823)
	[0.016]	[0.024]	[0.101]	[0.121]
Bluffor 2	0.801 **	0.975 **	0.883	0.569
	(0.387)	(0.398)	(1.690)	(1.535)
	[0.157]	[0.197]	[0.129]	[0.083]
Signaled 1		0.115		2.353 *
		(0.454)		(1.301)
		[0.020]		[0.247]
Signalor 2		0.546		1.259
		(0.466)		(1.027)
		[0.103]		[0.160]
Session Controls?	YES	YES	YES	YES
McFadden R^2	0.058	0.049	0.215	0.272
AIC	361.9	359.0	135.7	131.5
% correct	77.5%	77.5%	76.7%	77.5%

Standard errors clustered by round of play.
*** 1%; ** 5%; * 10%

Thus, if one bluffs in a round, then two rounds later, when s/he has the option again, then bluffing is more likely to occur. We conclude that Doc Hollidays persist in their play, while Honest Abes remain honest. This effect does not seem to arise in the likelihood of cheap-talk signaling. Additionally, those who have signaled and those who have experienced a cheap-talk signal will increase the likelihood that they signal in future rounds. The former is a statistically significant effect.

4.2 Searching for Honest Abe

While the baseline model does not consider heterogeneity in the players, the Honest Abe extension does. Honest Abes differ in their utility function and, consequently, are theorized to engage in bluffing at a different rate. Hence, if the sample of subjects is differentiated based on their observed bluffing behavior, Honest Abes, if they exist, are less likely to engage in bluffing. Therefore, as a way to investigate heterogeneity in the population, the subject pool can be partitioned by bluffing behavior.

The following table provides the subsample means for those who were the first to bluff in their session, those who never bluffed, and the rest of the sample who bluffed but only after others began bluffing. The assessments administered are used to differentiate subjects to identify whether or not there is heterogeneity in the subject population.

TABLE 8: Who is Honest Abe?

	# Safe Choices	*E1 – E2* (ambiguity)	*Dictator* (altruism)	% Males	Year in School
First Bluffers (*N* = 13)	5.62	-0.15	1.46	46.2%	2.38
Bluffers (*N* = 43)	5.87	1.19	1.80	64.3%	2.55
Never Bluffed (*N* = 61)	5.86	1.00	2.00	59.0%	2.61

The subsample of those who engaged in the first bluff of their session (10.2% of the sample) look substantially different than the rest of the population. They are less risk averse, choosing fewer safe options in the Holt-Laury assessment. Additionally, they are registered as having less ambiguity aversion. In fact, the sample of first bluffers are, on average, ambiguity loving (*E1 – E2* = 0 is ambiguity neutrality; *E1 – E2* > 0 is ambiguity aversion; *E1 – E2* < 0 is ambiguity love). Also, interestingly, the bluffers give substantially less in the Dictator Game. Finally, women are much more likely to be bluffers, as are younger students. Hence, this is suggestive evidence that play amongst heterogeneous actors is the appropriate framework to consider.[19]

5. Conclusion

We explore theoretically and experimentally the possibility of bluffing and engaging in signaling when such communication is costless (i.e., cheap talk) in a bargaining environment with asymmetric information. Without separate messaging, any signaling would be expected to be babbling and, consequently ignored. This would lead one to expect that bluffing would be ineffective. We build a

[19] Given that the sample of first-bluffers is small, statistical tests are frustrated. Conducting a one-tailed difference-in-means t-test, the gender distribution and ambiguity aversion differences are significant at the 10% level, while the risk aversion and Dictator differences are significant at the 20% level.

theoretical model, though, where bluffing and cheap-talk signaling occur with a positive probability in equilibrium. The equilibria can be Pareto-ranked and the equilibrium with no strategic information transmission is shown to be Pareto-inferior. An extension including the possibility of an Honest Abe in the game, who experiences a disutility from deceptive behavior, is considered. Ironically, the inclusion of Honest Abes increases deception in the game. An alternating-offers bargaining experiment is conducted with treatments varying the size of the costs to conflict and stakes of bargaining, as predicted to be drivers of behavior in comparative statics of the theory, are included. Along with establishing the prevalence of cheap-talk signaling and bargaining in the laboratory, we document a contagion effect. Experiencing a bluff causes a subject to create conflict in future interactions with different players. The contagion effect leads to overall more deadweight loss and encourages individuals to make more generous opening offers in an attempt, presumably, to reduce the destruction of bluffing. Cheap-talk signaling efforts are not reduced by the increase in bluffing, but rather the two co-move.

Additionally, further investigation into the functioning of the contagion effect is needed. One can hypothesize that exposure to bluffing adjusts an agent's empirical social norm expectations. This has been shown to predict, for example, altruistic giving in the Dictator Game

The results suggest that more attention needs to be paid to the role of costless communication of asymmetric information and, specifically, deception in economic environments. Individuals attempt to convey information through their actions even when standard, costly signaling (a la Spence (1973)) is not possible. These behaviors are not irrational, but rather can exist in equilibrium and can be escalated when individuals experience disutility from acting deceptively. Regulatory and legal institution design, for example, should consider how the established mechanisms facilitate or dissuade cheap-talking and bluffing as their use has welfare consequences.

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Appendix

The script used in the experimental sessions is provided.

Welcome to the research session in economics. We greatly appreciate your willingness to participate and help us with our project. We first want to provide some information before we start playing the games.

We are going to be playing a game and completing a survey. The game, though, will be repeated and divided into four different versions of the game. Each version of the game will be played four times. Soon we will be explaining the rules of the game. The survey will be given after the game.

We expect this session to last approximately one hour. You will be paid for participating. How much you earn will depend on the choices you make, the choices made by other players in the game, and luck. We expect on average people will make $20, but we guarantee that no one will make less than $10. You could earn more as well.

First, though, we need to go over the consent form.

[Go over the consent form and collect signatures before continuing]

Thank you. Now let's turn to the game.

In each round of each version of the game you will earning "points." These points will be cashed in for actual dollars. At the end of our session tonight, one round of the game will be selected at random. The number of points you earn in that round will be converted into real dollars at the exchange rate of 2 points = $1.

In the first version of the game you will be paired with someone in the next room to play a two-person game. One of you will be assigned the label of "Player A" while the other will take the label of "Player B." We will play this version of the game four times so that twice you will be Player A in the game and twice you will be Player B. In every round of the game you will be paired with someone different in the other room. The pairings will be made at random. At no time will you know the name of the person you are paired with nor will they know your identity.

The slides on the overhead screen will explain the rules of the game.

[Go through the slide presentation.]

[Provide an opportunity for subjects to ask questions.]

[Play the game]

That concludes the first of two activities. Now, we turn to the survey. In the packet of paperwork given to you there are a number of assessments. The first asks you basic background information. Using a pencil, respond to these on the scantron sheet provided.

After you have completed that, there are three additional assessments. The first one asks you to make a choice between either option (a) in the first column or option (b) in the second column. For each of the numbered choices 6-15 you are to select either (a) or (b).

For each option you are going to receive one of the two numbers. For option (a) you will receive either 10 or 8 points. For option (b) you are going to receive either 19.25 or 0.5 points. To play each lottery, a number between one and ten will be selected at random. If you choose option (a), for example, you will receive 10 points if one of the numbers associated with it are drawn and 8 points if the other numbers are drawn.

[Select one as an illustration – use the slides.]

Regarding compensation, one of the questions on the survey will be selected at random. The lottery will be played and you will receive real money based on how much you receive.

Complete the survey by filling in the option you wish to select on the scantron for each of the 10 decision problems.

The second assessment is another lottery. Here either the number 1 or 2 will be drawn. You will receive the associated outcome. Again, you are to select either option (a) or option (b). Make your selection in pencil on the scantron sheet provided.

The difference with this assessment is that for some choices you will see two numbers in brackets. This means that another selection of either the number 1 or 2. If 1 is selected, then the first number in the bracket is realized, while if 2 is selected the second one is chosen.

[Select one as an illustration – use the slides.]

Again, one of the lottery choices on these two assessments will be selected and the outcome you receive will be converted into real dollars. If an outcome on the second assessment is chosen, the points are converted into dollars at the exchange rate of 10 points = $1

[Ask for questions and answer. Make sure people understand the assessments.}

Finally, the third assessment asks to you answer a series of questions. Provide your answers on the scantron. When you are done with all three assessments bring your results to the front podium and receive your money. Thank you again!