Dyadic Processes of Disclosure and Reciprocity in Bargaining with Communication

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ABSTRACT

We offer a study revealing the mechanisms through which communication helps actual bargaining behavior outperform economic predictions. The possibility of individually strategic behavior in the presence of private information leads to game-theoretic predictions of less than full efficiency. We present a one-stage, simultaneous offers bargaining game in which buyers and sellers have independent, privately held valuations for the item being sold (i.e. a bilateral auction with two-sided private information). In three communication treatments, parties are: (a) allowed face-to-face communication prior to submitting offers; (b) allowed written communication prior to submitting offers; or (c) allowed no-communication prior to submitting offers. When parties are allowed pre-play communication, we find nearly full efficiency (98%). We examine two systematically predictable aspects of dyadic interaction—disclosure and reciprocity—to explain how negotiators achieve this efficiency. Copyright © 2002 John Wiley & Sons, Ltd.

KEY WORDS negotiation; bargaining; face-to-face; written communication; communication; reciprocity; coordination; honesty; bilateral auctions

Both economic and psychological research, as well as casual observation, provide ample evidence that negotiators often fail to behave in the manner envisioned by game-theoretic analyses of bargaining. Much of the existing research attempts to contradict the rationality assumption by providing evidence that negotiators systematically engage in faulty cognitive reasoning and, as a result, fail to reach optimal outcomes (Arrow et al., 1995; Bazerman, 2002; Kahneman & Tversky, 1993). This paper continues in the tradition of uncovering how actual negotiator behavior differs from existing game-theoretic models, but rather than concentrating on sub-optimal behavior, we are concerned with negotiated outcomes that are more efficient than equilibrium outcomes. And rather than focusing on features of individual cognition, we examine systematically predictable aspects of dyadic interaction to help account for situations in which negotiators outperform existing game-theoretic predictions.

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In many games with private information (any game in which not all of the payoff information is public), equilibrium models predict inefficiencies. Given the presence of private information and less than perfect alignment of interests across the players, models of rational bargaining behavior under standard game-theoretic assumptions predict failures to trade in some instances, despite the existence of a positive bargaining zone (Crawford & Sobel, 1982; Chatterjee & Samuelson, 1983; Farrell & Gibbons, 1989; Matthews & Postlewaite, 1989). The intuition behind the inefficient equilibria is that players holding private information will misrepresent their information in order to maximize their own payoffs. Furthermore, standard game theory predicts misrepresentation, and its subsequent inefficiencies, will occur even when communication between the players is permitted (Myerson & Satterthwaite, 1983).

We study a bilateral bargaining game in which a buyer and a seller receive private valuations from a single uniform distribution, have a period for thought and/or communication, and then privately submit bidding and asking prices for the valued item. The terms of trade are determined solely by the bid and ask. If the privately submitted bid is greater than the privately submitted ask, trade occurs at the midpoint.1 Myerson and Satterthwaite (1983) show that, in this game, there is no equilibrium solution that predicts fully efficient trade. Specifically, the equilibrium that maximizes expected gains from trade involves linear strategies that result in impasses in a substantial portion of cases in which a positive bargaining zone exists (Chatterjee & Samuelson, 1983). In a linear strategy, each party bids his or her true value adjusted by a constant, i.e. they ‘shade’ their bids. The adjustment serves to increase profit if a deal is struck, and only risks the loss of small value trades, thereby increasing expected value over all potential values of the item being traded. Myerson and Satterthwaite’s analysis concludes that even if the players were given the opportunity to communicate prior to play, there is no equilibrium of the enlarged game that produces higher expected gains from trade than Chaterjee and Samuelson’s linear equilibrium.

We study precisely this bilateral bargaining game, and include two treatments that allow communication between players prior to the simultaneous, private submission of bids and asks. Our results show outcomes that dominate the linear equilibrium and attain nearly full efficiency (i.e. trade if and only if the buyer’s valuation is greater than or equal to the seller’s valuation) when communication is allowed. We find that players reach pareto superior outcomes through one or more of three dyadic behaviors: (1) coordination on a single price; (2) mutual bidding of values; and (3) mutual revelation of values.

Our thesis is that strictly costless, non-verifiable and non-binding talk materially affects the process and outcome of negotiations. Negotiating parties often create interactions in which talk is treated as both verifiable and binding, though there are no within-game structures in place to either bind or verify. As in other social interactions, negotiations are guided by contextually driven norms and practices of interaction (McGinn & Keros, forthcoming). In our results and discussion, we explore how two practices of interaction observed in our study—disclosure and reciprocity—operate in opposition to economic assumptions of ‘cheap talk’. These practices drive outcomes that are substantially more efficient than game-theoretic equilibrium outcomes.

COMMUNICATION EFFECTS IN BARGAINING GAMES

This is not the first paper to present evidence that communication can produce outcomes superior to equilibrium predictions. Our contribution is an explanation of how norms and practices of communication trigger highly efficient performance in bargaining with private information. Research in the social psychological tradition has found that when communication is allowed in bargaining games with complete information (e.g. dilemma games or coordination games), negotiators systematically reach outcomes that are superior

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1 This game is commonly referred to as a double (or bilateral) auction with two-sided private information.
to economic predictions, even in one-shot, anonymous situations (Orbell, van de Kragt, & Dawes, 1988). Economic research has reached similar conclusions. In an early review, Hoffman and Spitzer (1982) concluded that face-to-face bargaining increased the likelihood of equal splits. Crawford (1990), though he explicitly excluded face-to-face communication in his review, argued that communication affects expectations and enhances coordination. In a meta-analysis of 57 different studies of prisoners’ dilemma and social dilemma games across disciplines, Sally (1995) found that face-to-face communication increased the likelihood of mutual cooperation by 43%, even after controlling for the loss of anonymity and expectations of future interaction.

Analogous evidence on the beneficial effects of communication has been reported in games with private information. In a winner’s curse game, where the buyer’s value for a good is yoked to the seller’s value but only the seller has valuation information, Valley, Moag, and Bazerman (1998) found that face-to-face communication during the bidding process enhanced efficiency over that realized with telephone or written communication. While the game-theoretic equilibrium of the winner’s curse game is impasse, Valley et al. (1998) found that over two-thirds of the dyads involved in face-to-face bargaining agreed to trades with positive returns to both parties. Relative to telephone and text-only interaction, face-to-face communication increased the likelihood of honest information exchange, even when such disclosure risked individual maximization of returns.

Similar efficiency-enhancing effects for communication have been found in games where both sides hold private information. Raiffa (1982) found 97% efficiency in face-to-face bilateral bargaining, relative to roughly 67% efficiency when bargaining took place through a double auction (the simultaneous submission of bids and asks, with an agreement to split the difference between the bid and the ask whenever the bid was greater than the ask). When Radner and Schotter (1989) allowed agreements to be reached through face-to-face bargaining rather than through a double auction, bargainers captured 99% of all available trades. Radner and Schotter do not investigate the sources of this efficiency, but speculate that the answer lies in social aspects of the unstructured bargaining game. Kagel and Roth (1995) in their Handbook of Experimental Economics offer two hypotheses for the heightened efficiency of bargaining with face-to-face communication: heightened social utility and supplementary channels providing additional information.

Valley et al. (2002) show similar efficiencies (94%) when face-to-face communication is allowed prior to determining price through a double auction, suggesting the answer lies not in unstructured bargaining relative to a bidding mechanism, but in the social aspects of communication itself. They provide evidence that the high rates of efficiency are due to enhanced coordination and lower rates of misrepresentation in face-to-face interaction, relative to written or no communication. As in the studies of games where only one side holds private information, honest disclosure appears to be a key to the efficiency-enhancing effects of communication in games with two-sided private information.

From a game-theoretic viewpoint, communication during bargaining with private information creates a signaling game (Spence, 1973), regardless of the medium in which the communication takes place. In a signaling game where communication is costless, non-verifiable, and non-binding, the communication is considered to be ‘cheap talk’ (Crawford & Sobel, 1982). ‘Non-verifiable’ means the receiving party cannot verify that the message is true. Verbal claims about one’s privately held valuation are non-verifiable in this sense (given the usual implicit assumption in economics that lies cannot be detected), whereas claims about publicly available facts (such as the gross earnings of a publicly held company) would be verifiable. ‘Non-binding’ means that, if the message contains a promise about future action, the receiver cannot force the sender to carry out this action. A message is non-binding if it is not possible to enforce contracts governing any of the actions under discussion. Verbal claims of willingness to take the good now and pay for it at a later date are non-binding in this sense (‘the check’s in the mail’), while an agreement of payment before delivery would be binding. Cheap talk can provide useful information to the receiver when three conditions are met: the sender’s preferences vary over receivers with different evaluations; the receiver’s preferences vary over the senders with different evaluations; and the interests of the parties are not in complete conflict (Gibbons,
1992). But cheap talk cannot entirely solve the problem of incomplete information unless the interests of the parties are perfectly aligned (Crawford & Sobel, 1982).

In many bargaining contexts, however, strictly costless, non-verifiable and non-binding talk is not ‘cheap’ (in the colloquial sense of low quality). Communication across bargainers materially affects the process and outcome of negotiations because parties treat the information provided in the communications as both verifiable and binding. Rather than relying on within-game structures in place to either bind or verify, they rely on contextually driven norms of honesty and disclosure in communication.

In this investigation, we study the bargaining game with bilateral private information, as described above. We introduce communication in the pre-bid period and predict that this communication will resolve the challenge of reaching an agreement, even in the presence of a restricted bargaining zone. Unlike Raiffa (1982) and Radner and Schotter (1989), but similar to Valley et al. (2002), we do not allow completely unstructured bargaining—we restrict communication to the pre-bid period, while the terms of trade are determined solely through the double auction that occurs subsequent to the communication period. We examine the dyadic behaviors observed when communication is allowed and point to the principles of disclosure and reciprocity underlying these behaviors, in an attempt to explain how communication triggers highly efficient performance in bargaining with private information.

METHOD

Participants and design
Fifty-two students in two graduate-level negotiation courses at Cornell University participated in the experiment. Thirty-six students from one class were divided into three sections of 12, six buyers and six sellers. Sixteen students from the second class were treated as a single section, eight buyers and eight sellers. Players were randomly assigned to a single role (buyer or seller) for the entire experiment. The communication treatments (described in detail below) were administered in different orders in the four different sections; otherwise, all four sections were treated identically.

Players participated in six rounds of bargaining across three communication treatments, each with a different partner, so that no pair negotiated more than once. Each round of bargaining included one buyer and one seller bargaining over the sale of a fictional commodity. Buyers’ and sellers’ valuations for the commodity ($v_b$ and $v_s$, respectively) were private information. It was common knowledge that all valuations were independently drawn from a uniform distribution of $0.00 to $50.00, with all $0.25 increments possible.

There were three communication treatments: no-communication, written communication, and face-to-face communication. The buyer and seller were in one of these three treatments prior to the submission of sealed bids/asks. In the no-communication treatment, buyers and sellers could not see one another and could not communicate with one another, but were given two minutes to consider their strategies between the time when they were informed of their value for the commodity and the time they submitted their bids/asks. In the written treatment, buyers and sellers could not see one another but were allowed a 13-minute period of pre-game communication in which written messages were exchanged. In the face-to-face treatment, buyers and sellers were given a 6-minute, pre-game period for face-to-face communication.

Players received an entire list of their partners for all rounds at the beginning of the session, so identities were known in all treatments. Prior studies of the effects of communication on bargaining with private information (such as Radner & Schotter, 1989) have confounded anonymity, the structure of the bargaining game, and communication. In our study, the game structure (double auction) and common knowledge of partner identity were kept constant across treatments to ensure that differences in results across treatments were attributable to communication treatments alone.

After the communication period, in all treatments, players privately submitted bids/asks. Buyers privately submitted bids for the commodity and sellers privately submitted asking prices. If the buyer’s bid ($p_b$) was
greater than or equal to the seller’s ask ($p_s$), the final price for trade was the average of the two prices, $p = (p_b + p_s)/2$. If trade occurred, the buyer’s profit was his or her privately realized value for the commodity minus the final price ($v_b - p$), and the seller’s profit was the final price minus his or her privately realized value for the commodity ($p - v_s$). If no trade occurred, each player’s profit was zero. All outcomes and payoffs were private.

**Procedure**

At the beginning of the experiment, each player received an envelope containing materials for the task. (See the Appendix for sample materials for the seller face-to-face treatment. A full set of experimental materials is available from the first author upon request.) Players were told to read only the first sheet and to look at the next sheet in the envelope only when instructed to do so. The first sheet was an overview with general information explaining the trading mechanism. The overview stated that all players were going to participate in an unspecified number of rounds. In each round, the buyer would have the opportunity to purchase a fictitious commodity, called Tynar, from the seller. Participants were given a list of all of the partner assignments for all players and all rounds. Players were told that each bargaining session had the potential for earnings or losses up to $50, and that one round would be randomly selected as the payoff round once all rounds were over.

Everyone was informed that at the end of all rounds they would receive limited feedback. For each round, they would be told: (a) whether or not a trade occurred; (b) if so, at what price; and (c) if so, their own profit. Players were never told the profit of the other party. The overview sheet explicitly stated, ‘Thus, there is no way to verify the other party’s valuation’.

After the general information was read, groups were divided into two rooms, one for buyers and another for sellers. When in the separate rooms, players were given specific role information and equations for how their profit would be determined. Players then completed a pre-negotiation questionnaire, composed of five questions designed to test their understanding of the game and their roles. In each question, they were given values and asked: whether mutually beneficial trade was possible; the maximum profitable bid for the buyer and minimum profitable ask for the seller; and the sale price and profits, given $v_b$, $v_s$, $p_b$, and $p_s$. The few instances of incorrect answers were discussed with the individual players.

After the questionnaire was collected, the bargaining rounds began. Each round had three phases. In the first phase, each person drew a card from a box to determine his or her value or cost for Tynar. The box held 201 cards—one card for each $0.25$ increment between $0.00$ and $50.00$. Each buyer and seller drew a card, recorded the value on a sheet provided and replaced the card in the box.

The second phase of each round contained the communication treatments. The buyer and seller were randomly assigned to one of the three communication treatments prior to the submission of sealed bids/asks. The first section (of twelve) played two no-communication rounds first, two written rounds second, and two face-to-face rounds last. The second section (of twelve) played two written rounds first, two face-to-face rounds second, and two no-communication rounds last. The third section (of twelve) and the fourth section (of sixteen) played two face-to-face rounds first, two written-communication rounds second, and two no-communication rounds last. The players were not informed at the beginning of play that there were different treatments, nor were they told at any time what treatment they would be playing in the next round(s).

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2A complete rotation of ordering would have required six sections, which we did not have. Order effects could potentially have weakened our findings in the following way: There is weak evidence that impasse increases with experience for small value trades under no-communication ($\chi^2 = 4.8, p = 0.091$), but there are no significant effects for experience in the written or face-to-face treatments. This is consistent with our conclusion that normative social practices are driving the effects with communication, but also suggests our findings may have been stronger had we fully crossed our order of treatment and/or had we allowed a higher number of rounds.
The third and final phase of each round was the submission of bids and asks. In all treatments, buyers and sellers were physically separated during this phase. Buyers were told that the bid should represent how much they would be willing to pay, and that the statement of a bid meant they would be willing to purchase the commodity from the seller for any price less than or equal to the bid. The instructions to sellers were analogous. Players were told they could submit only a specific monetary value for a price; no terms or conditions could be specified. Following the submission of a bid/ask, each player was asked to write down his or her best estimate of the other party’s valuation.

After the second round (and then again after the fourth round), players were instructed to take the next set of instructions out of their envelopes. These new instructions explained the new communication treatment. At the end of the six rounds, the groups gathered together. One person drew a card (6 cards, labeled 1 through 6) to determine the payoff round. One week later, players were given envelopes containing their monetary payoffs and information regarding their own outcomes for all rounds. Subjects were never informed of the outcomes of any other player for any of the rounds.

RESULTS

Communication, whether written or face-to-face, dramatically improved trading. Negotiators who were allowed to communicate achieved trades in 92% of the cases with positive gains from trade, compared to only 60% of those who did not communicate. The beneficial effects of communication were even more dramatic in the region where the linear equilibrium predicts no trade ($v_b < v_h < v_s + 12.5$). In this region, 80% of those who communicated achieved trade, compared with only 33% of those who did not communicate. Overall, pre-bid communication led to outcomes that realized 98.2% of the potential gains from trade, while no-communication outcomes captured only 80% of the potential gains from trade. We first present evidence about trade outcomes, and then investigate the bidding strategies and dyadic behaviors used to achieve these trading outcomes.

Trade outcomes

Because the parties’ valuations were drawn randomly, the buyer’s value was below the seller’s cost in some observations, so trade was not expected to occur (and did not). In 75 of the 156 observations, buyer values were greater than seller costs ($v_b > v_s$) and trade was possible. By chance, these observations were equally divided across the three communication treatments: 25 in each of the no-communication, written, and face-to-face treatments.

Exhibits 1(a)–(c) plot the 25 observations with $v_b > v_s$ for the no-communication, written, and face-to-face treatments, respectively. Each figure depicts the 45° line and the line below which the Chatterjee–Samuelson linear equilibrium predicts trade will not occur. Exhibit 1(A) shows that the predictions of the linear equilibrium (i.e. trade for all pairs above $v_b = v_s + 12.5$ but for none below) are reasonably well borne out in the no-communication treatment, whereas Exhibits 1(B) and 1(C) show that the parties achieve nearly all the efficient trades in the two communication treatments. The trade outcomes are summarized by treatment in Exhibit 2.

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3Applying Chatterjee and Samuelson’s linear equilibrium to our uniform distribution of 0–50: the buyer’s offer is (1) $p_b(v_b) = \frac{2}{3}(v_b) + \frac{1}{12}(50)$ and the seller’s demand is (2) $p_s(v_s) = \frac{2}{3}(v_s) + \frac{1}{3}(50)$. Recall that trade occurs in the double auction if and only if $p_b > p_s$. Manipulating (1) and (2) shows that $p_b > p_s$ in the linear equilibrium if and only if $v_b - v_s > \frac{1}{3}(50)$, i.e. the linear equilibrium applied to our distribution predicts trade for all pairs above $v_b = v_s + 12.5$ but for none below.

4Equilibrium predicts no agreement in this region. All four dyads reaching agreement in this region under the no-communication treatment did so because one of the two parties bid precisely his or her value. We discuss this behavior below.
Exhibit 1. Trade outcomes, (gains from trade $> 0$)
We test for the effects of communication treatment on these trade outcomes in logistic regressions in which the dependent variable is whether trade occurred. The independent variables are dummy variables for the two communication treatments (omitting no-communication). Because we have random draws of value pairs per treatment, it is possible that any findings concerning trade incidence are confounded by differences in the gains from trade \((v_b - v_s)\) across treatments. To control for this possibility, we also include gains from trade in the logistic regressions. The results of the logistic regressions are presented in Exhibit 3. For the 75 observations with positive gains from trade, the dummy variables for the communication treatments are highly significant but not significantly different from each other, providing evidence that both written and face-to-face communication increase the likelihood of trade. For the subset of 32 observations where the linear equilibrium predicts no trade \((v_s < v_b < v_s + 12.5)\), the same results hold but with somewhat less significance.

**Bidding strategies and dyadic behaviors**

To determine how the parties achieved a higher incidence of trade in the communication treatments, we first review individual strategies in the no-communication and communication treatments and then focus on dyadic behaviors in the communication treatments. In separate analyses of bidding strategies and dyadic behaviors in the written and face-to-face treatments, we found striking similarities and no statistically significant differences. Therefore, we hereafter pool the data on the two communication treatments. We restrict all of our analyses of bidding strategies and dyadic behaviors to the 75 observations with positive gains from trade.

It is clear that the parties in the communication treatments could not have produced the superior trading outcomes in Exhibits 1(B) and 1(C) by playing the linear equilibrium strategies with their resulting inefficiency, when \(v_s < v_b < v_s + 12.5\). Although the regression lines for both the no-communication and the

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**Exhibit 2. Trade outcomes by treatment (gains from trade > 0)**

<table>
<thead>
<tr>
<th>Trade/no trade</th>
<th>Trade/no trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Face-to-face</td>
<td>24/1</td>
</tr>
<tr>
<td>Written</td>
<td>22/3</td>
</tr>
<tr>
<td>No comm</td>
<td>15/10</td>
</tr>
</tbody>
</table>

**Exhibit 3. Logistic regressions of trade outcomes**

<table>
<thead>
<tr>
<th>Trade</th>
<th>(v_b &gt; v_s)</th>
<th>(v_s &lt; v_b &lt; v_s + 12.5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-1.951 (0.890)</td>
<td>-1.409 (1.111)</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>-2.193 (0.028)</td>
<td>-2.168 (0.205)</td>
</tr>
<tr>
<td>(p &gt; \mid z \mid)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gains from trade</td>
<td>0.181 (0.063)</td>
<td>0.111 (0.137)</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>2.881 (0.004)</td>
<td>0.810 (0.418)</td>
</tr>
<tr>
<td>Written dummy</td>
<td>2.568 (0.964)</td>
<td>2.151 (1.042)</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>2.664 (0.008)</td>
<td>2.064 (0.039)</td>
</tr>
<tr>
<td>Face-to-face dummy</td>
<td>3.197 (1.269)</td>
<td>2.854 (1.295)</td>
</tr>
<tr>
<td>(s.e.)</td>
<td>2.519 (0.012)</td>
<td>2.203 (0.028)</td>
</tr>
</tbody>
</table>

\(N = 75\)

\(\chi^2(3) = 28.20\)

\(p = 0.000\)

\((\chi^2 \text{ test, written } = \text{ face-face})\)

\(\chi^2 = 0.25, p = 0.619\)

\(N = 32\)

\(\chi^2(3) = 8.23\)

\(p = 0.042\)

\((\chi^2 \text{ test, written } = \text{ face-face})\)

\(\chi^2 = 0.30, p = 0.582\)
communication treatments were not statistically different from the strategies in the linear equilibrium (buyers, \( p = 0.81 \) and \( p = 0.70 \), respectively; sellers, \( p = 0.58 \) and \( p = 0.67 \), respectively), we show below that in the communication treatments, this test of the linear strategy is misleading—the estimates of the players’ strategies suffer from omitted-variable bias. Players were using information beyond their individual valuations to determine their bids.

Further investigation of the data shows that, within each bargaining pair, the bidding strategies are best understood as reflecting dyadic behaviors rather than individual strategies. We observe, first, that in some dyads, both parties reveal their valuations (judging from each party’s precisely correct guess of the other’s valuation). In addition, we observe two dyadic strategies: (1) in some dyads, both parties bid the same price (and this price was often halfway between the parties’ valuations); (2) in some dyads, both parties bid their valuations.

We turn first to a non-strategic dyadic behavior, ‘mutual revelation’. After each round, each party was asked to estimate the other’s valuation. In many cases, one party’s estimate was precisely equal to the other’s valuation. We assume this results from truthful information exchange in the pre-play communication phase (rather than chance) and call this ‘revealing one’s valuation’. Exhibit 4 shows that revealing one’s valuation is reciprocal behavior. It is highly correlated within dyads: in 29 of the 50 dyads at least one party revealed his or her valuation, but in 13 of the 29 dyads both parties did so (\( r = 0.35, p = 0.012 \)). Mutual revelation of values does not determine the parties’ bids, and cannot be considered a ‘strategy’. A critical, empirical feature of mutual revelation, however, is that in all cases it led to one of the two dyadic strategies, either coordination on a single price or mutual bidding of values, discussed below.

In 21 of the 50 dyads in the communication treatments, the buyer and seller named exactly the same price, and in four others the buyer’s price was less than $0.05 greater than the seller’s. We say that these 25 dyads ‘coordinated on a single price’. Exhibit 5 shows the buyers’ share of the gains from trade in the 25 dyads that coordinated on a single price. Six dyads coordinated on a price exactly half-way between the buyer’s value and the seller’s cost; nine others produced a payoff for the buyer that was between 40% and 60% of the total gains from trade. Given private valuations, this coordination at the midpoint must have been achieved through either mutual and honest information sharing (as in the four cases where the strategy was preceded by mutual revelation) or roughly reciprocal concession behavior.

In the 50 communication cases, eleven buyers and six sellers bid their values exactly, including several with quite extreme values; three other buyers and five other sellers bid one cent less/more than their values. We describe this behavior as ‘bidding one’s valuation’. We also observed 11 incidents of this behavior by buyers or sellers in the no-communication treatment. The difference in the communication treatments is the

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5 We thank an anonymous reviewer for pointing out the potential for order effects as a way of explaining the non-strategic behavior under no-communication. Of the 11 buyers or sellers bidding their values in this treatment, 8 had previously been exposed to both face-to-face and written treatments. Though statistically no-communication bargaining gets more strategic with experience, social practices with communication appear to ‘rub off’ in subsequent no-communication interactions.
high incidence of reciprocal behavior, of mutual bidding of values. Exhibit 6(a) shows that bidding one’s valuation in the communication treatments is highly correlated within dyads: in 15 of the 50 dyads at least one party bid his or her valuation, but in 10 of these 15 dyads both parties bid their valuations ($r = 0.74$, $p < 0.001$). Exhibit 6(b) shows the analogous results for the no-communication treatment: in 11 of these dyads at least one party bid his or her valuation, but there are no cases of both parties doing so ($r = -0.28$, $p = 0.17$). Thus, bidding one’s value is not unique to the communication treatments, but when pre-bid communication is allowed, reciprocity comes into play and bidding one’s value typically occurs as dyadic behavior. We call this dyadic behavior ‘mutual bidding of values’.

Exhibit 6(a). Reciprocity in bidding one’s value, communication cases (gains from trade > 0)

<table>
<thead>
<tr>
<th>Buyer bids value</th>
<th>Seller asks cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>35</td>
<td>1</td>
</tr>
<tr>
<td>Yes</td>
<td>4</td>
<td>10</td>
</tr>
<tr>
<td>Total</td>
<td>39</td>
<td>11</td>
</tr>
</tbody>
</table>

Exhibit 6(b). Reciprocity in bidding one’s value, no-communication case (gains from trade > 0)

<table>
<thead>
<tr>
<th>Buyer bids value</th>
<th>Seller asks cost</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>Yes</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>19</td>
<td>6</td>
</tr>
</tbody>
</table>
Although mutual bidding of values achieves the same outcome as coordination on a single price halfway between the buyer’s value and the seller’s cost, the strategic considerations differ considerably. Once the parties agree to coordinate on a given price, neither party has any incentive to change his or her bid—if the buyer bids less or the seller asks more than the agreed upon price, no trade will occur. In contrast, if both parties agree during the communication phase to bid their values, there is a tremendous incentive not to do so in the bidding phase. By shifting one’s bid to the other party’s valuation, for example, one could capture all the gains from trade instead of half, or at least protect oneself from another party with the same, duplicitous strategy. Thus, coordination on a single price during the communication phase is self-enforcing, while mutual bidding of values rests on some rationale other than strategic considerations. We propose possible non-strategic rationale for this behavior in the next section.

Exhibit 7 summarizes our analysis of dyadic behaviors. In total, 35 of the 50 dyads with positive gains from trade in the two communication treatments engaged in one of the two dyadic strategies described above. In thirteen of these cases, the strategies rested on mutual revelation.

Restatement of results based on dyadic behaviors
We, like others before us (Hoffman & Spitzer, 1982; Radner & Schotter, 1989; Raiffa, 1982), found that communication improves the efficiency of bargaining in games with incomplete information. But our study goes beyond simply presenting the superior outcomes, and reveals the source of this increased efficiency with communication: dyadic behaviors built on a foundation of honest disclosure and reciprocity. Our findings regarding the role of dyadic behaviors suggest potential omitted variables from the linear strategy regression of buyers’ bids as a function of their values: the seller’s cost and ask also affect the buyer’s behavior. Using the data from our communication treatments, when we regress buyer’s bid on buyer’s value, seller’s cost, and seller’s ask, the coefficient on the seller’s cost ($\beta = 0.60, t = 5.8$) is now nearly as large as that on the buyer’s value ($\beta = 0.79, t = 11.2$), the coefficient on the seller’s ask is similar in magnitude but opposite in sign ($\beta = -0.53, t = -3.8$) and the $R^2$ is 0.85 (relative to $R^2 = 0.69$ in the individual—buyer’s bid on buyer’s value—strategy regression). The expanded regression re-emphasizes that dyadic behaviors are the key to our analysis and it reveals how misleading a conventional individual strategy regression (buyer’s bid on buyer’s value) is in the presence of disclosure and reciprocity.
DISCUSSION

Our findings, and those of others before us who have shown the efficiency enhancing effects of communication, point to the need for a fundamental shift in explaining competitive behavior in the presence of communication—away from individual strategies and toward dyadic behaviors. When parties are not allowed to communicate in a bargaining game with private information, their behavior approximates that of standard game-theoretic actors. But the opportunity for communication adds social complexities to their behaviors and their strategies. Players who communicate prior to bidding reach mutually beneficial trades far more frequently than predicted by the linear equilibrium, achieving nearly full efficiency.

While a strategy such as coordination on a single price is an equilibrium game-theoretic analyses (e.g. Matthews & Postlewaite, 1989), using communication to coordinate on prices that accurately reflect both the buyer’s value and the seller’s value is not. Note that there were no verification or enforcement mechanisms available. Nor were the preferences of the parties perfectly aligned—both preferred agreement to no agreement when \( v_b > v_s \), but buyers preferred a lower price while sellers preferred a higher price. In spite of this, communication accurately revealed private information and often resulted in similarly revealing responses. In games with private information and communication, even costless, non-binding, and unverifiable talk often involves honest disclosure and reciprocity. These practices create the possibility of nearly full efficiency, by moving behavior away from individual strategies and toward the dyadic strategies—coordination on a price and mutually bidding of values.

The presence of communication fundamentally changes the perceived constraints and expectations in the bargaining game. Consider a hypothetical negotiation between Parties A and B. First, our data on revelation of private information suggests that Party A may feel constrained to not misrepresent private information. Although full and honest disclosure across both parties occurs in only a minority of the communication cases (13 of 50 pairs), over 50% of the individual communications were fully revealing, i.e. precisely revealed private valuations. Second, the correlation of revealing behavior within dyads suggests that Party A has reason to expect Party B to act like Party A is acting—for B to bid his or her own value if A does so, or for B to reveal when A reveals. Below, we discuss the principles of disclosure and reciprocity as the social psychological explanation for this phenomenon. Both disclosure and the reciprocation of disclosure may appear to be misplaced trust or naiveté. Our data suggest, instead, that honest disclosure and reciprocity are common practices of human interaction in the presence of communication.

Economic models assume that, in the absence of verification and/or enforcement mechanisms, players can (and will) misrepresent their valuations without cost or constraint. In contrast, research on deception in psychology and anthropology often assumes honesty, concentrating on when and why people would go against social norms and lie (Robinson, 1996; Bok, 1978). When parties interact face-to-face, or when the parties both belong to an intact social network as they often do in ‘real-world’ business negotiations and as they did in our study, honest disclosure may be a much more accurate prediction of behavior than standard assumptions of costless and unconstrained misrepresentation. But while an assumption of honest disclosure would be parsimonious, and does provide a better description of much of the behavior observed in our communication treatments than an assumption of opportunistic misrepresentation, it not only contradicts the basic axiom of self-interest, it is also naive. It is difficult to conclude that honest revelation, purely for the sake of honesty, is an accurate portrayal of the majority of human interaction.

Social psychological research on the detectability and assumed detectability of lies suggests an additional incentive for people to tell the truth in bargaining: they tell the truth because they believe that the other party will know if they’re lying. At least some people appear to be good at detecting deception, and can differentiate with better than chance accuracy when someone is telling the truth from when they are lying (DePaulo & DePaulo, 1989; Ekman, 1992; Ekman & Friesen, 1969; Ekman, Friesen, & Scherer, 1976). Though the empirical work on the accuracy of lie detection is far from concluding that all of us can detect lies and liars, these findings cast doubt on the heretofore unexamined, game-theoretic assumption
of ‘inscrutability’—that a player can utter any lie without emitting any indication of the existence or scale of the lie. Research on the illusion of transparency suggests that, far from assuming inscrutability, people overestimate the detectability of their own lies, and behave accordingly (Gilovich, Savitsky, & Medvec, 1998). In our data, the frequency of honest disclosure is relatively constant across face-to-face and written communication treatments. The social norms in this context appear to support honest disclosure in communication regardless of medium. We return to this point below.

Preferences for disclosure, based on either social norms or the assumption of lie detection, may explain the frequency of honest revelation in our data, but such preferences do not provide a satisfactory explanation for the mutuality of revelation we observed. Instrumentally, once the first party has revealed his or her valuation, a mutually agreeable bid can be offered by the second party without any reciprocal revelation. Another feature of social interaction, the norm of reciprocity, reduces the likelihood of an instrumental response to disclosure. Reciprocity, the tendency to mutually give or take, is one of the most pervasive and well-documented norms of human behavior (Altman & Taylor, 1973; Gouldner, 1960). In economic exchanges, reciprocity dictates that actions be responded to in kind (Fehr & Gächter, 2000; Kreps et al., 1982; Mills & Clark, 1982; Ortmann, Fitzgerald, & Boeing, 2000; Weingart et al., 1999), i.e. if you reveal your valuation during bargaining, I will (and you will expect that I will) reveal mine. In our data, reciprocity of either disclosure or bidding one’s value occurred in over 50% of the bargaining pairs who were permitted to communicate.

The dyadic behaviors we observed become transparent in the light of the research on disclosure and reciprocity: If Party A discloses, either because of social norms or because she believes Party B can detect misrepresentation, the norm of reciprocity demands that Party B disclose as well. Incorporating these social features into game theoretic models would require the revision of two assumptions frequently underlying economic analyses of bargaining. First, the assumption of opportunism would need to be replaced with the assumption that (a) some portion of the population discloses, and (b) another (potentially overlapping) portion practices reciprocity, even when it is counter to individual rationality. The probability of these complementary events could be modeled to vary with the demands of the social context. Second, instead of assuming and modeling individually strategic behavior, strategic behavior could be modeled at the dyadic level, such that the parties together create a mutually beneficial ‘strategy’ that maximizes the chance of a fully efficient agreement, e.g. coordination on a price or mutual bidding of values. Again, the probability of a leap from individual strategic behavior to dyadic strategic behavior would vary with social context. Revising these assumptions in our models would lead to potentially more accurate predictions than those derived from existing game-theoretic models of communication in bargaining.

Disclosure and reciprocity are not standard behaviors in all environments. The social context in which the bargaining is embedded will affect the likelihood of disclosure and reciprocity and, therefore, the extent to which efficiency is enhanced relative to standard game-theoretic equilibria. Valley et al. (2002) used the same protocol we present here, but the players in our study had pre-established and ongoing relationships due to their mutual participation in the same semester-long course, while the players in their study were strangers who were not parties to the same social network. Two important differences in results across the studies suggest a refinement of any general conclusion that communication improves efficiency through the possibility of disclosure and reciprocity. First, as in our study, Valley et al. found greater efficiency when communication was allowed prior to bidding, but they observe higher levels of trade with face-to-face communication than with written communication. We observe no such difference: the parties achieved nearly full efficiency in both the written and the face-to-face treatments. Second, while Valley et al. find that some parties coordinate on a price, they find only three incidents of mutual revelation in 70 observations (4%, relative to our finding of 26%), and no incidents of mutual bidding of values. Recall our earlier discussion noting the strategic differences between coordination on a price and mutual bidding of values—mutual bidding of values requires trust and trustworthiness, while coordination on a price is self-enforcing. Examining the differing outcomes in light of the social contextual distinctions between the studies suggests that there may be an interactive effect between communication medium and social knowledge, such that less rich communication forms are equally
useful for promoting disclosure and reciprocity when social knowledge is present, but only face-to-face interaction is likely to promote these behaviors in the absence of social knowledge. McGinn and Keros (forthcoming) provide empirical evidence of this interaction effect. Their qualitative analyses of negotiation transcripts suggest that face-to-face interaction greatly increases the likelihood of cooperation in bargaining between strangers, while having little marginal effect on the (consistently high) level of cooperation between friends.

Reputation effects and incentive levels are additional social contextual variables affecting the likelihood of reciprocity and disclosure and the efficiency of trades. Mirroring the social context in many real-world negotiations, all of our negotiators were drawn from the same, dense social network, making it likely that reputation effects played a role in the outcomes. These reputation effects may have increased the frequency of disclosure and reciprocity in the interactions we studied. But our design makes it unlikely that differences across treatments resulted from potential reputation effects. In all treatments, and in every round, each player knew the identity of and was familiar with the other party, so that full knowledge of the other player’s identity was present across all treatments. The players knew that each would receive information only about their own outcomes, and not that of any of the other players. Reputation effects may have led parties to shade less across the board. But, since the identity of the other party was known in all treatments, and there was no way to verify actual values in any treatment, it is difficult to attribute our results to reputation alone, without invoking an interaction between reputation and communication, and subsequent effects on honest disclosure and reciprocity. Similarly, higher incentives may have decreased the likelihood of disclosure and reciprocity overall, but it is difficult to ascertain how increasing the stakes in all treatments could eliminate the differences in efficiency across treatments. Regardless of reputation and incentive issues, communication introduces the potential for disclosure and reciprocity, behaviors that are impossible without communication and foreign to standard game-theoretic models of bargaining behavior.

The most important contribution of this paper is to point out how an understanding of social psychological principles of interaction can inform analyses of bargaining. We offer this work as part of a growing literature on psychological influences leading to behavior that departs from standard economic assumptions. But, this time, the departures are positive, rather than the negative departures offered by behavioral decision theorists. Behavioral decision research has had notable influence on decisions within organizations because its description of behavior as deviations from rationality suggests clear targets for improvement. Similarly, social psychological research on social interaction has the potential to identify processes that routinely increase the efficiency of agreements reached in competitive, social contexts. The equilibrium solutions derived from game-theoretic models of bargaining can begin to adequately describe the behavior of players in social contexts only if they begin to account for the heightened potential for honest disclosure and reciprocity when parties communicate.

APPENDIX: MATERIALS

Tynar overview
In this exercise, you will participate in a series of negotiations. In each negotiation, there will be a Buyer and a Seller. You will remain in the same role in all negotiations. You will negotiate with a different person in each negotiation. Please read closely all of the information below. You will have an opportunity to ask questions about anything you do not understand.

In each negotiation, you will bargain over a fictitious commodity called Tynar. Buyers value Tynar at a given value, which will change in each negotiation. The Seller has a cost for Tynar, which will also change in each negotiation. The Buyer makes money by buying Tynar at a price lower than the given value. The Seller makes money by selling Tynar at a price higher than the given cost.

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6Only face-to-face seller materials are presented here. Written and no-communication materials vary in the last two pages. A full set of materials is available from the first author.
The Buyer’s value and the Seller’s cost are independent. Both, however, will be randomly drawn from the same distribution—$0–$50. Thus the Buyer’s value will change in each negotiation and can vary across negotiations from $0–$50, inclusive. Similarly, the Seller will be given a new cost for Tynar each round, and the cost can vary across negotiations from $0 to $50, inclusive. The Buyer’s value in any negotiation may be above, below, or equal to Seller’s cost. Only the Buyer will know the Buyer’s value and only the Seller will know the Seller’s cost.

Each negotiation has the potential for earnings or losses up to $50 across the Buyer and the Seller.

The price at which Tynar is traded (if it is traded) in any negotiation is determined jointly by the Buyer’s Bid and the Seller’s Asking Price. As long as the Buyer bids more than the Seller is asking, the trade will occur at the midpoint. For example, if the Buyer bids $10 and the Seller asks $5, the trade will occur at $7.50 \[\frac{(10 + 5)}{2}\].

If the Buyer bids $5 and the Seller asks $10, no trade occurs in that negotiation.

Buyers make a profit by trading at a price less than their value for the Tynar. Sellers make a profit by trading at a price higher than their costs.

Specifically:

Buyer Profit = Buyer Value – Trading Price
Seller Profit = Trading Price – Seller Cost

After the negotiations are over, a participant will randomly select one negotiation to be the payoff round. You will be paid whatever you earned in that round.

Below are some examples:

Seller’s Cost: $4.00
Buyer’s Value: $22.00
Seller’s Asking Price: $16.00
Buyer’s Bid: $20.00
Buyer Bid > Seller Asking Price, so Trading Price = \((16.00 + 20.00)/2\) = $18.00
Seller earns (trading price – cost) or $18.00 – $4.00 = $14.00
Buyer earns (value – trading price) or $22.00 – 18.00 = $4.00

Seller’s Cost: $20.00
Buyer’s Value: $17.00
Seller’s Asking Price: $20.00
Buyer’s Bid: $17.00
No sale takes place, since Buyer bid < Seller asking price
Seller earns: $0.00
Buyer earns: $0.00

Seller’s Cost: $12.00
Buyer’s Value: $10.00
Seller’s Asking Price: $12.00
Buyer’s Bid: $13.00
Buyer bid more than Seller asked, so Trading price = \((13.00 + 12.00)/2\) = $12.50
Seller earns (trading price – cost) or $12.50 – 12.00 = $0.50
Buyer earns (value – trading price) or $10 – 12.50 = <–$2.50> Notice: This is a loss to the Buyer. The Buyer lost only because s/he chose to make a Bid above his or her value for Tynar.
Be careful not to lose money in this exercise
Please take this opportunity to ask the experimenter any questions you may have about the exercise.

After questions, before you begin the negotiations, please answer the questions on the next page.

Seller
Negotiation and payment details
Each negotiation takes place in three steps: (1) You will draw a card from a box to determine your cost for this negotiation; (2) You will communicate face-to-face with the Buyer; (3) After the communication period is over, you will go back to the seller classroom and submit a private Asking Price for the Tynar.

Specifically:

(1) You have drawn a cost from a box containing 201 cards, each representing one $0.25 increment between $0 and $50, inclusive. Please record this cost on the seller Record Sheet. There is one Sheet for each negotiation.

(2) The Record Sheet is not to be taken out of the Seller Classroom. You may want to note your partner’s name and your cost for Tynar for the upcoming negotiation before you go out of the room to the negotiation.

(3) You have 6 minutes to communicate face-to-face with the Buyer. You may talk about anything you would like during this communication period. After the 6 minutes are over, you must stop all communication.

(4) At the end of the 6 minute communication period, please go back to the central seller classroom, to the seat you were assigned. On your desk is your Record Sheet for the negotiation just completed. Record your Asking Price on the Seller’s Record Sheet. This Asking Price is the price at which you are willing to sell the Tynar. Your statement of Asking Price means you are willing to sell Tynar for any price more than or equal to the price you listed. This Asking Price is the minimum you are willing to accept for the Tynar. You may ask only a specific monetary value—in other words, no terms or conditions may be added to your Asking Price. Then, complete the rest of the Record Sheet, answering all the questions asked.

(5) Bring the completed Record Sheet from the negotiation you just finished up to the front of the classroom.

At the same time as you submit your Asking Price, the Buyer will be submitting a private, sealed Bid for Tynar. The Bid will state the maximum s/he is willing to pay for the sale of Tynar. In order for any transaction to occur, the Buyer must bid as much as or more than the Seller is asking for the Tynar. If this occurs, the Tynar is sold at the price exactly midpoint between the Buyer’s Bid and the Seller’s Asking Price (the midpoint or average of the two values).

At the end of the series of negotiations, a participant will randomly select the round for which you will be paid.

Pre-negotiation questions
1. If the Buyer’s value is $4.00 and the Seller’s cost is $5.00, is a mutually profitable trade possible?
2. If the Buyer’s value is $46.00, what’s the most s/he can bid for the Tynar and still be sure to make a profit if a trade occurs?
3. If the Seller’s cost is $12, what’s the lowest price s/he can ask and still be sure to make a profit if a trade occurs?
4. If the Buyer’s value is $32.00 and the Seller’s cost is $8.00, and the Buyer bids $26.00 while the Seller asks for $20.00, will a sale take place?
   If so, at what price?
   How much would the Buyer earn?
How much would the Seller earn?

5. If the Buyer’s value is $13.00 and the Seller’s cost is $15.00, and a trade takes place at $16.00, how much does the Buyer earn?

How much does the Seller earn?

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