Behind the Screens: Does the Coase Theorem Hold Online? *

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Abstract
Rapid technological diffusion has led to a heavy reliance on digital communication media, fundamentally changing how people transact and coordinate. This paper studies how adopting digital communication impacts efficiency and welfare distributions in a Coasian bargaining experiment. We find that digital negotiation leads to a nearly fourfold increase in self-regarding behavior and a 22.9 percent decrease in efficient decision making, relative to bargaining face-to-face. Given how the COVID-19 pandemic has both highlighted and exacerbated the migration of traditionally face-to-face activities like working and learning to an online setting, our results offer timely insight into some potential effects of this transition.

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1 Introduction

Technological diffusion and innovation have gradually increased our dependence on telecommunication to conduct transactions, coordinate behavior, and achieve cooperative outcomes. We now negotiate digitally in online secondary markets like Craigslist, eBay, Facebook Marketplace, and many others; work groups allocate tasks and collaborate using digital communication media; telecommunications allow students and academics to learn and work collaboratively from around the globe; asset allocation, contract negotiation, and dispute resolution often occur via digital media; and medical information and counseling now transpire via teleconferencing.[1]

The recent global pandemic has greatly exacerbated this digital dependence, forcing rapid adoption of both infrastructure and habits that will likely yield permanent changes in how we use technology to interact.[2,3] Although digitized communication introduces many benefits (e.g., speed, convenience, and supply) it also introduces new behavioral considerations such as increased social distance and anonymity, which in turn affect the quality of communications.[4]

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[1] Facebook Marketplace saw 18 million new listings during May 2017 and estimates that the buying and selling experiences led to growth of 77 percent in users who may not have connected otherwise (Cohen 2017). In only two years after its launch in 2015, Letgo, another online marketplace, saw 75 million downloads of its marketplace application, 200 million listings, and 3 billion messages (Lowe 2017).

[2] For example, Dingel and Neiman (2020) find that 37.5 percent of jobs in the U.S. can be performed at home, and that these jobs typically pay higher than average wages. Brynjolfsson et al. (2020) estimate the fraction of workers who switched to working from home at 35.2 percent after the COVID-19 pandemic hit, with an additional 15 percent reporting they were already working from home before that, which suggests about half the workforce is now working from home. Similarly, in the Alignable network, 45 percent of firms report having any workers switch to working remotely during the COVID-19 pandemic, and responses from the National Association of Business Economists survey indicate 50 percent of firms have more than one-fifth of their employees working remotely (Bartik et al. 2020).

[3] Erel and Leibershon (2020) find that the financial services industry has become increasingly digital after the pandemic. The results are more pronounced in areas with lower incomes and a larger minority share of the population, and in industries with little ex ante small-business lending, where borrowers were more likely to get a FinTech-enabled Paycheck Protection Program loan if they were in ZIP codes where local banks were unlikely to originate such loans.

[4] A large literature has studied the role of social distance and anonymity in various settings. Examples include: Roth and Malouf (1979); Hoffman et al. (1994); Hoffman et al. (1996); Laury et al. (1995); Eckel and Grossman (1996); Bohnet and Frey (1999); Valley et al. (2002); Naquin and Paulson (2003); Dufwenberg and Muren (2005); and Charness and Gneezy (2008).

The goal of this paper is to provide new evidence on how this transition moderates interactions along two important dimensions: allocative efficiency and welfare distribution. Specifically, we study how efficiency and allocations in a Coasian bargaining game change when we migrate negotiations from a face-to-face to a digital setting. Though others have studied differences in how face-to-face and digital communication yield different outcomes, we are the first to implement carefully designed protocols that allow for a strict test of the Coase theorem (Coase 1960) in both a face-to-face and digital setting with the purpose of understanding the effect of communication medium on bargaining outcomes.

To do this, we replicate seminal experimental bargaining protocols implemented in Hoffman and Spitzer (1982; 1985; 1986, HS hereafter) that satisfy the assumptions of the Coase theorem and enable a test of its predictions. Their approach across several studies was to vary elements of the bargaining problem that might affect Coase's theorem, including the initial assignment of property rights, the level of transaction costs, whether the interaction was one-shot or repeated, and the number of bargaining parties. These studies were also conducted in a setting where fairness considerations were likely to matter most — bargaining face-to-face. They found that factors outside the scope of the theorem significantly affected the likelihood of a successful negotiation, the efficiency of the bargain, and the distribution of gains.

We then extend these protocols to a digital setting. We vary the strength of property rights (strong or weak), whether bargaining is repeated (one-shot or two-shot), and the bargaining environment (face-to-face or digital), which yields a 2x2x2, between-subjects design with subjects in each treatment making a total of ten bargaining decisions. Our primary interest lies in how this move from a face-to-face to a digital bargaining environment impacts efficiency and allocations.

Consistent with HS (1982; 1985), we find that subjects in face-to-face bargaining sessions frequently obtain the Pareto efficient outcome (more than 80 percent of the time). Further, we find that most of these face-to-face bargaining outcomes involve nearly equal splits. This is true in both one- and two-shot bargaining settings and with both strong and weak property rights. Transitioning to a digital bargaining environment yields a 22.9 percent decrease in efficiency, constituting a significant efficiency cost. Additionally, we observe that subjects with property rights (Controllers), who can make unilateral

decisions, are nearly 4 times more self-regarding in the digital environment. These Controllers consistently deny propositions that would result in higher efficiency but require them to sacrifice earnings relative to what they could earn via the unilateral payoff maximizing decision. Efficiency also increases as subjects gain experience in both settings. However, while the likelihood of achieving an efficient outcome increases to nearly 100 percent in the later rounds of negotiating face-to-face, the number is capped at around 80 percent for digital negotiations. This increase in efficiency corresponds to a decrease in how much money Controllers sacrifice, relative to the unilateral maximum, when accepting bargaining proposals.

Our findings indicate that moving to a modern negotiation platform changes bargaining behavior among subjects and show that both total and relative welfare are sensitive to the negotiation environment. Particularly, the drop in efficiency (and fairness) suggests that moving the negotiation online affects the validity of Coase's prediction, possibly because the screen results in less effective communication and greater social distance between subjects. Given that our bargaining setting preserves features of many others in which fluid communication is necessary to complete a transaction, settle a dispute, or assign responsibilities and tasks, we believe our findings provide new insight into how changes in communication media influence coordinated task and pie-cutting behavior in many general negotiation settings.

2 Literature Review

2.1 Bargaining and Fairness

HS (1982; 1985) design an experimental environment that implements the assumptions of the Coase theorem as closely as possible. We discuss their designs in detail, as they are the basis for our own study. HS (1982) set up a simple bargaining problem, where groups of two (or three) subjects are randomly assigned to the roles of player A or player B, and negotiate over seven possible outcomes, with

sample payoffs shown in Table 1.[5] Each row of the payoff table is numbered (0-6) and consists of specific payoffs to player A and player B. Notice that one of the payoff pairs is clearly more efficient – in this case number 1, with payoffs totaling $14. The pair negotiates face-to-face over which number to choose. One member of the pair is chosen as the "Controller," and that person has "property rights" in the decision. The Controller may simply choose an outcome, and then the experiment comes to an end. But the other party can "attempt to influence the Controller to reach a mutually acceptable joint decision; the other participant may offer to pay part or all of his or her earnings to the Controller." (HS 1982, p. 83). Suppose the controller is Player A. Notice that the Controller can choose to equalize payments on his own by selecting number 2, or can maximize his own payoff by choosing 6, at a significant sacrifice in efficiency. But he can achieve a higher payoff for both by choosing 1 and accepting a side payment from the other player. If a joint agreement is reached, both parties sign a written document stating the agreement.

Table 1. Sample Payoffs from HS (1982).

Decision Table		
Number	*Payoff to Player A*	*Payoff to Player B*
0	0.00	12.00
1	4.00	10.00
2	6.00	6.00
3	8.00	4.00
4	9.00	2.00
5	10.00	1.00
6	11.00	0.00

HS explore several different treatments in a between-subjects design. HS assign property rights randomly in all treatments, and vary two factors in the design. The first factor is the number of periods (1 or 2), which tests whether the prospect of repeated interaction enhances equal division. This behavior was of interest due to the predominance of equal division outcomes in the prior bargaining literature (see Roth

[5] The three person games involved one controller and two non-controllers but were otherwise the same. We did not replicate the three-person games, and do not discuss these treatments further.

1995 for a review). The second factor is information: either there is full information, with both players having full information about payoffs, or asymmetric information, with each player only knowing his own payoffs.

The results show strong support for the efficiency prediction of Coase (1960), with 95 percent of pairs choosing the joint-payoff-maximizing number. Repeated interaction led to a higher frequency of equal divisions (90 percent of repeated, compared to 33 percent of one-shot interactions).[6] Finally, some controllers sacrificed their own earnings to achieve a more equal division, accepting less than they could have guaranteed themselves on their own. This result prompted HS to further investigate the roles of entitlement and fairness in determining payoff distributions in a second study (HS 1985). HS hypothesized that randomly assigned property rights failed to create a moral basis for self-regarding behavior. The second study introduced two methods of reinforcing property rights, to give controllers a greater sense of entitlement: competition, where the role of controller is determined by a contest; and entitlement framing, where the Controllers are told they "earned" their role. The study is a 2x2, between-subject design, with full information about payoffs. Results are shown in Table 2:

Table 2. Efficiency and Sharing Outcomes from HS (1985).

	Neutral language		**Entitlement language**	
Random entitlement	*N*	22	*N*	20
	Efficient	20 (.91)	*Efficient*	19 (.95)
	Equal division	10 (.5)	*Equal division*	9 (.47)
Game entitlement	*N*	22	*N*	22
	Efficient	18 (.82)	*Efficient*	21 (.95)
	Equal division	9 (.5)	*Equal division*	4 (.18)

Notes: The leftmost column indicates the property rights assignment mechanism used. The top row of each property rights assignment indicates the total number of decisions made in each property rights-language treatment cell. Below the number of decisions made in each treatment cell, we present the total number of efficient decisions made, the total number of decisions where an equal division of the available surplus was realized, and in parentheses the fraction of the total number of decisions that these outcomes constitute.

[6] Most bargaining outcomes in the repeated interaction setting involved an equal splitting of money.

As in the previous study, HS observed high rates of efficiency: 91 percent of pairs across treatments (78/86) selected the payoff-maximizing number. There were no significant differences across cells in the degree of efficiency, showing that efficiency was robust to both competition and entitlement priming. The combined effect of game plus entitlement language substantially impacted equal divisions, and their measure of inequality of payoffs (the "greed index") shows greater inequality, with both entitlement-enhancing methods leading to higher levels of the index.

Many bargaining experiments extended this work. HS (1986) extended their protocol to groups of 4, 10 and 20 participants. They show that more than 90 percent of groups achieve efficiency in full- and limited-information settings for all group sizes. Cherry and Shogren (2005) further reinforce the importance of property rights; they studied how transaction costs affect bargaining in settings with secure and insecure property rights and found that bargaining efficiency is inversely related to property right security.[7]

2.2 Communication and Social Distance

Face-to-face communication leads to more efficient outcomes in a variety of game settings. For example, in public goods games, open face-to-face communication leads to efficient levels of cooperation and provision of public goods (e.g., Ostrom and Walker 1991; Ledyard 1995; Ahn et al. 2003; Cardenas et al. 2004; Volland and Ostrom 2010). Moreover, face-to-face interaction also makes others' payoffs more salient, leading to more other-regarding behavior in the form of equalizing payoffs (e.g., Bohnet and Frey 1999). Social distance makes communication more difficult, but at the same time it tends to make the preferences and outcomes for others less salient. Thus, greater social distance would tend to reduce efficiency, and at the same time reduce other-regarding behavior.

Many papers have examined the role of anonymity in bargaining games, the simplest of which is the dictator game, where one player determines the allocation of resources between themselves and another person. In effect, the "dictator" is like the Controller in the HS games. Early bargaining studies

[7] Hoffman and Spitzer's early work was part of the inspiration for many subsequent studies that explored entitlement and fairness in bargaining and in markets (Kahneman et al. 1986, 1990; Thaler 1988; Guth and Tietz 1990; Cherry et al. 2002). Hoffman et al. (1994) explored property rights and fairness in ultimatum and dictator games.

showed high levels of cooperative behavior, and results tended to contradict simple game-theoretic models that assume payoff-maximizing agents: subjects were much too kind to each other. Hoffman et al. (1994; 1996) argued that the lack of anonymity in bargaining games might be an important factor in producing these cooperative outcomes. They developed a procedure to ensure that the dictator-game giving was anonymous and blind to the experimenter. The effect of this "double blind" procedure was to substantially reduce other-regarding behavior. Bohnet and Frey (1999) explored the role of social distance in dictator games and found that the dictators were more other-regarding when they knew more personal information about recipients.[8] Charness and Gneezy (2008) examined how behavior changes in dictator games with varying degrees of anonymity and social distance. They found that revealing some information of recipients, such as family name, to dictators caused more generosity. Thunström et al. (2016) show that dictators often prefer to reduce social distance by finding out the deservingness level of recipients, and they act on that frame by giving more to deserving recipients. Eckel and Petrie (2011) allow subjects to purchase access to a partner's photo before making a decision in a trust game and find trust is higher when photos are purchased, both senders and responders send more money when a photo is observable and when it is purchased.

2.3 Digital vs. In-Person

Psychologists and ergonomic researchers studying digital versus in-person interactions have shown there is less reliance on social cues and more equal participation when communicating digitally (Keisler et al. 1984; Rice 1987; Adrianson and Hjelmquist, 1991; Dubrovsky et al. 1991; Hiltz et al. 1986; Weisband et al. 1995), that agreements routinely take longer online since communication is not synchronous and negotiators employ different tactics (Hiltz et al. 1986; Keisler and Sproull 1992; Valacich et al. 1993; Galin et al. 2007), and that online negotiators reported feeling less satisfied with

[8] Many subsequent papers have explored other-regarding behavior from a theoretical and experimental perspective. See Cooper and Kagel (2009) for a survey.

their outcomes, less trusting of their partner, and having less desire for future interaction with the same partner (Naquin and Paulson 2003).[9]

Economists have focused on when and how communication media influence coordination, cooperation, trust, and reciprocity. Evidence is mixed. Some studies find that digitizing communication (without a video image) reduces cooperation, coordination, and efficiency. Frohlich and Oppenheimer (1998) study prisoner's dilemma games across email and face-to-face environments and find that electronic communication is less helpful than face-to-face communication for cooperation, particularly when the nature of the decision and the content and information needing to be communicated are complex. Brosig et al. (2003) study a cooperation game using face-to-face, video, and audio communication and show that visual cues conveyed face-to-face and in video settings are a crucial component of cooperation. Bicchieri and Lev-On (2007) study a social dilemma game and find that cooperation is more difficult to establish and maintain in a computer-based setting, which is not as effective as a face-to-face setting at inducing preferences and expectations conducive to cooperation. Diermeier et al. (2008) study coalition formation and find that groups negotiating face-to-face were significantly more efficient than those using a computer (70 percent versus 11 percent). Rocco and Warglien (1996) find increases in opportunistic behavior and communication breakdown in social dilemma games in a computer mediated setting. Online negotiation settings are also conducive to cheating (Conrads and Lotz 2015; Cohn et al. 2018) and poorer promise-making (but not promise-keeping) behavior (Conrads and Reggiani 2016).

However, other researchers find that digital communication has no deleterious impact on interactions. Croson (1999) studies negotiation behavior in integrative (i.e., win-win) games and finds no losses in efficiency across the two environments and that computer-mediated agreements are significantly more equal than face-to-face agreements. Abatayo et al. (2018) find that young adults are equally adept at achieving and sustaining cooperative agreements when communicating within an online Facebook group

[9] Bordia (1997) provides a review of early experimental studies of face-to-face versus computer-mediated communication, and Geiger (2020) provides a review of theoretical vantage points on communication media and negotiation, and summaries of empirical findings from papers over the last six decades.

chat as they are in person. Galeotti et al. (2019) study how subjects trade off efficiency for equality in online bargaining and find that subjects prefer efficiency over equality. Bochet et al. (2006) find high levels of cooperation and efficiency in voluntary contribution experiments in treatments where subjects communicate through a computer chat room and face-to-face, but not in the treatment where communication was limited to numerical signals.

People opt into negotiations more often in digital than face-to-face settings because online settings reduce confrontation costs (Gago 2019), which have been shown to lead to worse outcomes (Brooks and Schweitzer 2011). Although agents may use online chat for screening and that signaling content embedded in chat has value (Babin 2018), the findings in the literature allude to face-to-face communication being more effective when the information needing conveyance has deep substance or complexity, when there is a need to establish what both individual and group interests dictate, when subtler cues are needed to engender a cooperative atmosphere, and when fairness is a concern.

2.4 Bargaining and (e-)Commerce

Backus et al. (2020a) study bargaining delay resulting from a lack of communication using eBay's Best Offer platform and find that one-third of bargaining interactions end in immediate agreement and the rest in delayed agreement or disagreement. Backus et al. (2020b) show that allowing for communication can reduce the cost of bargaining delays on eBay Germany's Best Offer platform. This suggests that digital communication media that lead to asynchronous communication may increase negotiations costs relative to face-to-face settings. Many other behavioral patterns exist among bargainers and are important to understand for both efficiency and fairness. For example, Maciejovsky and Wernerfelt (2011) show that buyers and sellers are more willing to bargain over pooled prices in face-to-face settings than digital settings. Similar heuristics have also been shown in studies using e-commerce data (e.g., Backus et al. 2019; Coey et al. 2020) and in other important settings (e.g., Allen et al. 2019; Byrne et al. 2019; Camerer et al. 2019).

3 Experimental Design & Lab Procedures

Our study replicates key elements of HS (1982; 1985) and extends their work to a computer-mediated setting. We use a 2x2x2, between-subjects design with three factors: property rights assignment, repeated bargaining, and bargaining environment. First, rather than replicate all four treatment combinations in HS (1985), we focus on the two extremes and consider two types of property rights: strong property rights (competing for rights and entitlement priming) and weak property rights (randomizing rights and no entitlement priming). Second, following HS (1982), we have subjects engage in either one-shot or two-shot bargaining. Third, we have subjects bargain either face-to-face or anonymously on a computer. Additionally, we expand the number of bargaining decisions that subjects face to increase the amount of data per subject. Subjects made a total of 10 bargaining decisions each. Subjects in one-shot sessions bargained 10 times with a total of 10 partners, and those in two-shot sessions bargained 10 times with a total of 5 partners (two periods each). The payoff table changed each bargaining period, but the structure of the payoffs was the same as in Table 1 and payoffs to both players in each period were always common knowledge. Subjects also completed a short demographic survey after all 10 rounds had been completed

We implemented all research protocols from HS (1982; 1985), described above. We recruited undergraduate students from Texas A&M University using ORSEE (Greiner 2004). We conducted 16 sessions (2 per treatment) with 12 subjects each. We conducted all sessions between December 2016 and September 2017. We randomly selected two bargaining decisions for payment. For two-shot sessions, we paid subjects for both bargaining decisions made with a single partner. For one-shot sessions, we paid subjects for two bargaining decisions made with two different partners.[10]

[10] In the nine sessions that took place between December 2016 and May 2017, we paid subjects a $5 show up fee. In the seven sessions that took place in September 2017, we paid subjects a $10 show-up fee due to a change in lab policy.

3.1 Lab Procedures for Face-to-Face Sessions

We implement complete stranger matching for both one- and two-shot bargaining sessions.[11] We arranged the laboratory to create maximal distance between bargaining stations to allow privacy between bargaining pairs.[12] The moderator read instructions aloud for each session, and we also provided paper instructions for reference.[13] We concluded instructions with a comprehension quiz that we checked individually before proceeding. During bargaining, Controllers always had the unilateral ability to choose a payoff allocation for both players in each period, and the opportunity to entertain offers from the Bargainer to select a different allocation and or a potential transfer money between one another. The exact payoff changed each period, but the structure of the payoffs was the same as in Table 1 (see Appendix C for a list of payoff tables used). Payoffs to both players were common knowledge each period. Once a pair finished bargaining and completed and signed the contract in a period, they signaled an experimenter who collected payoff tables and the contract and instructed subjects to wait quietly until all pairs finished bargaining.

Face-to-Face Property Rights:

We allocated *weak property rights* randomly via coin flip at the pair level. If the result of the coin flip was heads, the subject with the lower identification number in each pair was told they were *designated* as the Controller for that period (we assigned each subject a unique identification number between 1 and 12 during check-in). We allocated *strong property rights* by having subjects play a deterministic hash mark game (see Appendix A.2), and the winner was told they had *earned the right* to be the Controller for that period.[14]

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[11] Complete stranger matching means two people never matched more than once. See Appendix A.1 for a full description of our face-to-face matching protocols.

[12] Approximately 12- to 15-feet of distance separated each bargaining station. HS had subjects bargain publicly so our goal was only to prevent bargaining parties from overhearing one another and adopting one another's bargaining strategies and provide privacy from experimenter scrutiny.

[13] See Appendix A.2 and Appendix A.3 for the instructions used in all face-to-face sessions, and Appendix A.4 for the agreement form that bargaining pairs filled out and signed after finishing each decision.

[14] We asked subjects to record a strategy for this game. There is no evidence that any subject solved the game.

3.2 Lab Procedures for Digital Bargaining Sessions

We used the same laboratory as in the face-to-face sessions, and ensured all subjects were seated at a computer with an empty computer station between subjects. The same moderator read instructions aloud for each session, and we also provided paper instructions for reference.[15] We concluded instructions with a comprehension quiz that we checked individually before proceeding.

We conducted all digital bargaining sessions with a digital interface programmed using ZTree (Urs Fischbacher, 2007). This program used previously generated complete-stranger matches each period for one-shot sessions and every two periods for two-shot sessions (subjects in the digital sessions used the same set of payoff tables that were used in the face-to-face sessions, see Appendix C). A period of bargaining in the digital environment always had the same flow as in face-to-face bargaining. After Controllers selected a unilateral decision for implementation in cases of bargaining failures, Bargainers learned of this decision. Next, subjects used a chat box to bargain with one another. If subjects agreed to a mutual decision, both players could indicate this with a button provided on the chat screen. If both subjects clicked this button, then the Bargainer completed a contract and forwarded it to the Controller for approval. Controllers could refuse a contract for any reason. If a Controller refused a contract or did not engage in bargaining, the program implemented the Controller's unilateral decision and the period ended. If the Controller approved the contract, then the program implemented payoffs according to the terms of the contract and the period ended.

Digital Property Rights:

We allocated *weak* property rights at the pair level using a random number generation. We allocated *strong* property rights by having subjects compete in a simple addition task for time. Though this competition task is different than the one employed during face-to-face bargaining, we saw little difference in the frequency of role switching as a result. We chose a programmable task that we thought best replicated the deterministic, competitive properties of the hash mark game described above. We

[15] See Appendices B.1 through B.4 for the instructions used in all digital sessions, which include screenshots of the bargaining interface at all stages.

further discuss in the results section why we believe that this difference had no impact on behaviors across environments.

4 Results

4.1 Replication of HS

In the face-to-face treatment, we first replicate the research protocols employed in the two-person, full-information bargaining treatments from HS (1982). We consider our replication successful if we obtain a significant result in the same direction as the result of interest in the original study, which is the most rigorous replication standard (as measured by relative replication rates) used in Camerer et al. (2016). HS (1982) focused on two things: testing the predictive power of Coase's bargaining theorem and understanding how strategic considerations might alter bargaining outcomes in repeated interactions. Table 3 reports the numbers and percentages (in parentheses) of efficient and 'sharing' allocations for both one- and two-shot bargaining within and across each study. Following HS, we define *sharing* as any allocation where Controller and Bargainer payoffs are within $1 of equality.[16]

We use Fisher's exact tests to test for statistical differences in the proportions of efficient and sharing allocations both within and across studies.[17,18] We observe an equivalently high proportion of efficient decisions ($p > 0.10$, Fisher's exact test). Comparing across the two studies, Fisher's exact test indicates there are no statistically significant differences in the proportions of efficiency achieved in one-shot ($p = 0.64$) and two-shot ($p = 0.11$) bargaining. Thus, we replicate HS's efficiency results. Regarding payoff distributions, we replicate the finding that Controllers in two-shot bargaining are other-regarding. However, we observe no statistical difference in the proportion of sharing decisions between our one- and

[16] For example, if the joint payoff of an allocation is $14, then ($7, $7) and ($8, $6) are sharing allocations but ($9, $5) is not.

[17] Fisher's exact test is a proportions test that is designed for use in small sample sizes.

[18] HS find no statistically significant difference in the number of efficient decisions in their one- and -two shot bargaining environments, but they do find a difference in the number of sharing decisions.

two-shot bargaining treatments ($p > 0.10$, Fisher's exact test). Thus, we fail to replicate HS's finding that repeated interaction increases other-regarding behavior.[19]

Table 3. Baseline Results for Repeated Bargaining and Comparing to HS (1982; 1985).

		HS Data	***Our Data***	***Fisher's Exact (HS vs. Us)***
1-Shot Bargaining	*N*	12	24	
	Efficient	11 (.92)	20 (.83)	$p = 0.11$
	Sharing	5 (.42)	18 (.75)	$p = 0.48$
2-Shot Bargaining	*N*	34	24	
	Efficient	32 (.94)	19 (.79)	$p = 0.11$
	Sharing	26 (.76)	19 (.79)	$p = 1.00$
Fisher's Exact (1-Shot vs. 2-Shot)	*Efficient*	$p = 1.00$	$p = 0.34$	
Fisher's Exact (1-Shot vs. 2-Shot)	*Sharing*	$p = 0.04$	$p = 0.36$	

Notes: The leftmost column indicates one-shot or two-shot bargaining sessions. The top row within each of these panels indicates the total number of decisions made in the HS experiments and ours. Below the number of decisions in each outcome panel, we present the total number of efficient decisions made (joint payoff is maximized), the total number of sharing decisions (the available surplus is distributed within one dollar of an equal-payoff division), and in parentheses the fraction of the total number of decisions that these outcomes constitute. In the bottom two rows and the rightmost column, we report the *p*-values for Fisher's exact tests for one- and -two shot sessions within and across each study. Of the 34 observations in the 'HS Data' two-shot bargaining panel, 12 are from the two-shot full-information (coin flip) sessions in HS (1982), and 22 from the two-shot no-entitlement (coin flip) sessions in HS (1985). The 'HS Data' one-shot bargaining panel includes 12 observations, all of which come from their one-shot full-information (coin flip) sessions in HS (1982) since one-shot bargaining was not used in HS (1985). Results reported in the 'Our Data' columns (or panels) include data from only the first two periods of the face-to-face, coin flip (weak property rights) no entitlement priming sessions.

We now turn to HS (1985), which tests the role of entitlement to property rights on bargaining behavior. We present the efficiency and sharing results across property rights assignment treatments in Table 4. We find equivalently high levels of efficiency in our strong and weak property rights treatments ($p > 0.10$, Fisher's exact test). We do not find a statistically significant difference between the proportions of sharing allocations in our weak and strong property rights sessions ($p > 0.10$, Fisher's exact test). Hence, we also replicate HS's finding that strength of property rights does not moderate efficiency but fail

[19] Note that when using an equal split definition of sharing, our results do not change across one-shot and two-shot environments. However, the statistical difference in the proportion of sharing between one- and -two shot bargaining in HS disappears as there are four fewer sharing decisions in their two-shot bargaining sessions under this definition.

to replicate their finding that strengthening property rights reduces the proportion of sharing allocations obtained in face-to-face bargaining.

Table 4. Baseline Results for Property Rights Assignment and Comparing to HS (1985).

		HS Data	Our Data	*Fisher's Exact (HS vs. Us)*
Strong Property Rights, 2-shot	*N*	22	24	
	Efficient	21 (.95)	15 (.63)	$p < 0.001$
	Sharing	7 (.32)	12 (.50)	$p = 0.245$
Weak Property Rights, 2-shot	*N*	22	24	
	Efficient	20 (.91)	19 (.79)	$p = 0.418$
	Sharing	14 (.64)	18 (.75)	$p = 0.525$
Fisher's Exact (Strong vs. Weak)	*Efficient*	$p = 1.00$	$p = 0.34$	
Fisher's Exact (Strong vs. Weak)	*Sharing*	$p = 0.069$	$p = 0.14$	

Notes: The leftmost column indicates the property rights assignment mechanism used. The top row of each property rights assignment panel indicates the total number of decisions made in the HS experiments and ours. Below the number of decisions made in each treatment cell, we present the total number of efficient decisions made (joint payoff is maximized), the total number of sharing decisions (the available surplus is distributed within one dollar of an equal-payoff division), and in parentheses the fraction of the total number of decisions that these outcomes constitute. All 22 observations for each panel in the HS column come from the weak property rights sessions (random entitlement plus no entitlement priming) and strong property right sessions (game entitlement plus entitlement priming) in HS (1985). Results reported in the 'Our Data' column include data from only the first two periods in each respective set of two-shot treatment sessions.

We provide additional results from HS (1985) alongside our own in Table 5, which reports an Average Greed Index (AGI), a measure of self-regarding behavior introduced by HS (1985).[20] The AGI measures how much more a Controller earns for a given bargaining outcome than what she would have earned from an equal-split payoff. Thus, an AGI > 0 indicates an unequal payoff favoring the Controller, an AGI = 0 indicates an equal split, and an AGI < 0 indicates an unequal payoff favoring the Bargainer. Table 5 shows that, similar to HS (1985), we find that strong property rights produce more self-regarding behavior than do weak property rights (testing $AGI_{strong} > AGI_{weak}$ yields $p = .094$). Thus, we find results

[20] We use the two-shot bargaining data from the first two periods of our face-to-face, weak-property-rights sessions and from our face-to-face, strong property rights sessions to replicate HS (1985).

consistent with those of HS that strong property rights induce more self-regarding behavior than do weak property rights, as measured by the AGI.

Table 5. Impact of Entitlement and Fairness on Payoff Distributions.

	Strong Property Rights		**Weak Property Rights**	
	HS Data	***Our Data***	***HS Data***	***Our Data***
Average Greed Index	$4.52	$1.10	$1.00	$0.23

Notes: The AGI is calculated by taking the difference between a Controller's final payoff and what she would have earned from choosing an equal split of the total payoff for that realized decision outcome, and then computing the average of this difference for all decisions made in each treatment. 22 observations were used to estimate the AGI for each HS panel, which come from the strong property right sessions (game entitlement plus entitlement priming) and weak property rights sessions (random entitlement plus no entitlement priming) in HS (1985). Results reported in the 'Our Data' columns include data from only the first two periods (24 observations) in each set of two-shot treatment sessions.

To summarize, we replicate the finding that subjects negotiate efficient allocations, that efficiency is equally high in one-shot and repeated bargaining, and that efficiency is invariant to the strength of property rights. Additionally, we replicate the finding that strong property rights produce a higher AGI, but fail to replicate the finding they produce a different proportion of sharing allocations than weak property rights. However, unlike HS, we do not find that one-shot bargaining produces more self-regarding behavior than does two-shot bargaining.

4.2 Main Results: Face-to-Face vs. Digital Environment

We now turn to an analysis of the full data from our experiment and compare the two bargaining environments with respect to efficiency and other-regarding behavior.

4.2.1 Efficiency

Table 6 and Figure 1 report aggregate summaries on the number and proportion of efficient allocations achieved in each of our four treatment types in face-to-face and digital environments. First, we note that the communication environment itself impacts efficiency. Proportions testing shows that efficiency for each of our four treatment types is significantly lower in the digital environment than in the face-to-face environment (using Fisher's exact tests, $p < .01$ for all treatments except the weak property

rights, repeated bargaining treatment, which has $p = .018$). 90 percent of the face-to-face and 67 percent of the digital pairs select the efficient outcome ($p < 0.001$, Fisher's exact test).

Table 6. Efficiency Outcomes.

	Face-to-Face		**Digital**		***Fisher's Exact Test***
Strong, 1-shot	*N*	120	*N*	120	
	Efficient	112 (.93)	*Efficient*	78 (.65)	$p < 0.001$
Strong, 2-shot	*N*	120	*N*	120	
	Efficient	109 (.91)	*Efficient*	84 (.70)	$p < 0.001$
Weak, 1-shot	*N*	120	*N*	120	
	Efficient	106 (.88)	*Efficient*	70 (.58)	$p < 0.001$
Weak, 2-shot	*N*	120	*N*	120	
	Efficient	106 (.88)	*Efficient*	91 (.75)	$p = 0.018$
Total	*N*	480	*N*	480	
	Efficient	433 (.90)	*Efficient*	323 (.67)	$p < 0.001$

Notes: The leftmost column indicates the property rights assignment mechanism used. The top row of each property rights assignment panel indicates the total number of decisions made across face-to-face and digital sessions. Below the number of decisions made, we present the total number of efficient decisions made and in parentheses the fraction of the total number of decisions this constitutes.

Proportions testing also confirms that there is no interaction between environment and property rights; varying the strength of property rights does not cause different rates of efficiency in either the face-to-face or digital environment ($p > 0.10$ for each proportions test, using the full dataset). However, we reject the null hypothesis ($p = .015$, using a proportions test and data from all 480 digital bargains) that subjects bargain to efficient outcomes at the same rate in the one-shot and two-shot settings in the digital environment. Subjects are significantly less likely to achieve an efficient outcome whenever engaging in one-shot bargaining in the digital environment ($p < .01$ using a two-sided *t*-test). This result is driven mostly by differences in efficiency that occur in one-shot relative to two-shot bargaining in the digital, weak property rights sessions, as there are 17.5% more efficient decisions made in two-shot bargaining than in one-shot bargaining sessions ($p = .006$, Fisher's exact test). This difference in efficiency does not appear in the strong property rights sessions ($p = .58$, Fisher's exact test).

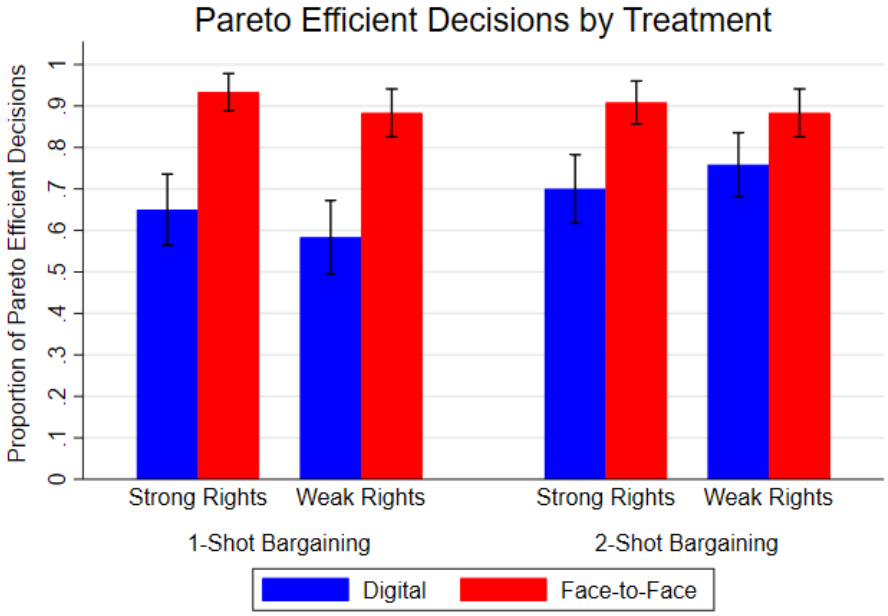

Figure 1: Each of the eight treatments described here consist of 120 decisions made by 12 subject pairs across 10 bargaining periods. The difference in the proportion of PE decisions between the matching digital and face-to-face settings is highly significant ($p < .01$) according to both a proportions test and Fisher's exact test.

In Figure 2, we present the proportion of efficient decisions made in each treatment by period. A difference in efficiency rates across communication environments persists throughout all 10 periods in each of the one-shot treatments, and in 9 of 10 periods in the strong, two-shot treatment. In the weak, two-shot treatment, differences in the percentage of efficient decisions disappear entirely by the 5th period.

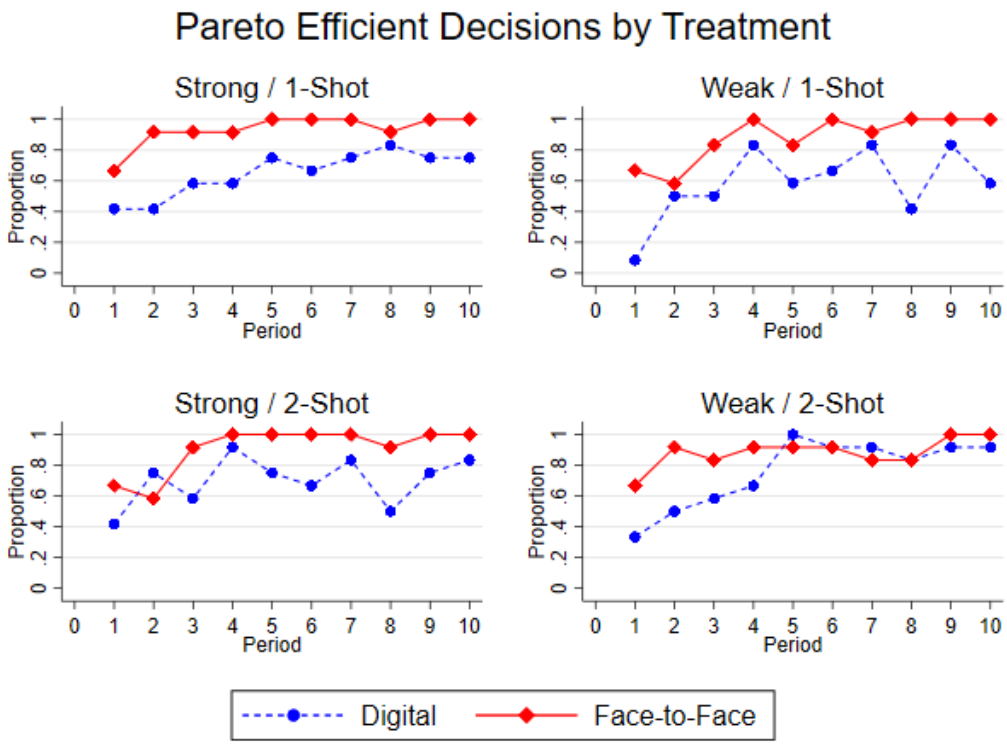

Figure 2: Each panel of Figure 2 shows the percentage of efficient decisions made in both face-to-face and digital bargaining environments for each of our four treatment types. Each period comprises 12 decisions made by 24 subjects for each of the face-to-face and digital environments.

In Figure 3, we present the aggregate proportion of efficient decisions made in each period and environment. It shows that the gap in efficiency rates between the two environments closes over time but that learning subsides about halfway through sessions and a clear difference in efficiency persists ($p < .001$, Fisher's exact test using data from all bargains in each environment). Though subjects participating in digital bargaining can learn through experience to achieve a higher rate of efficient outcomes, they are unable to converge to complete efficiency as are subjects participating in face-to-face bargaining.

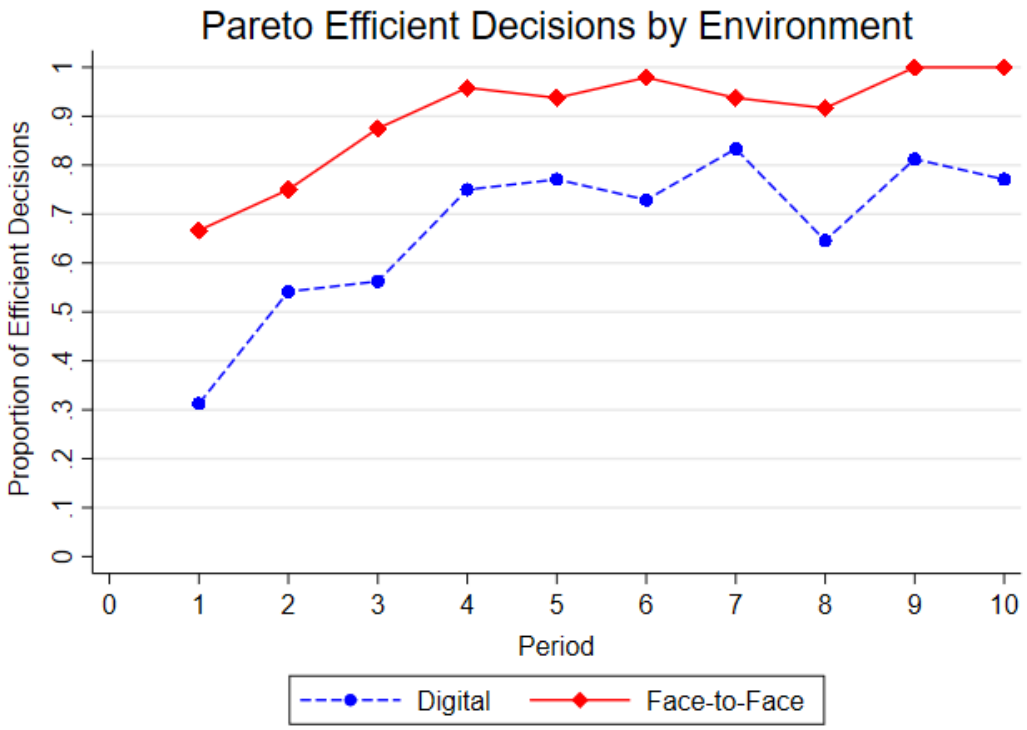

Figure 3: 96 subjects made a total of 48 decisions in each environment for each period. Subjects make significant improvements as they gain experience in early periods but learning levels out around period four. Subjects learned at about the same rate in each environment but subjects in the digital environment failed to converge to complete efficiency as did subjects bargaining in the face-to-face environment.

A by-round proportions test reveals that, aside from round seven, the difference in the proportion of efficient decisions between the two environments is significant ($p < .05$).[21] Marginal effects from a probit regression indicate that moving from the face-to-face to the digital environment yields an approximately 22.5% decrease in the probability of subjects bargaining to an efficient allocation. Aside from rounds seven, five and two, the difference is significant at $p < .01$.

4.2.2 Payoff Distributions

We now turn our focus to payoff distributions. To start, we compare the AGI across bargaining environments in Table 7 and across environments by treatment and period in Figures 4a and 4b. Panel 1 reports the average AGI of all decisions, including equal splits, across all periods of each treatment for each bargaining environment. Panel 2 reports the same but only includes decisions that were not equal

[21] Aside from rounds seven, five and two, the difference is significant at $p < .01$

splits. Finally, panel 3 reports the proportion of decisions that were not equal splits for all eight treatments. We see from column one of panels 1 and 2 of Table 7 that moving from a face-to-face to a digital bargaining environment more than quadruples the AGI from 0.73 to 2.96 ($p < 0.001$, using a t test). Although we see the AGI increases when moving to the face-to-face environment regardless of the property rights assigning mechanism and the repetition of bargaining, most of this difference is driven by treatments featuring either strong property rights, one-shot bargaining, or both. This indicates that Controllers are more likely to behave in an individually rational way and most self-regarding in the digital environment.

Table 7. Average Greed Index.

Panel 1: AGI Including Equal Splits

	All Treatments	***Weak 1-Shot***	***Weak 2-Shot***	***Strong 1-Shot***	***Strong 2-Shot***
Face-to-Face	.73	.35	.26	.97	1.25
Digital	2.96	3.04	.71	4.23	3.87

Panel 2: AGI Without Equal Splits

	All Treatments	***Weak 1-Shot***	***Weak 2-Shot***	***Strong 1-Shot***	***Strong 2-Shot***
Face-to-Face	1.95	1.75	1.78	1.48	2.79
Digital	3.95	3.73	2.38	4.34	4.26

Panel 3: Proportion of Non-Equal Splits

	All Treatments	***Weak 1-Shot***	***Weak 2-Shot***	***Strong 1-Shot***	***Strong 2-Shot***
Face-to-Face	.375	.2	.2	.65	.45
Digital	.75	.82	.3	.98	.91
Observations	960	240	240	240	240

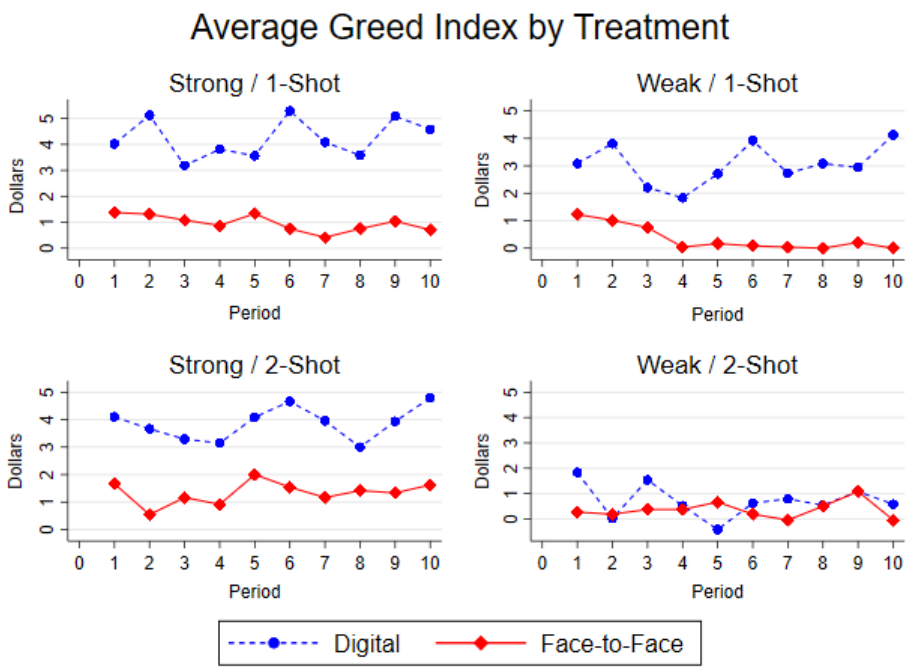

Figure 4a: The Average Greed Index for each of our eight treatments. The data used in this figure include all 960 observations across all 10 periods of bargaining from both communication environments

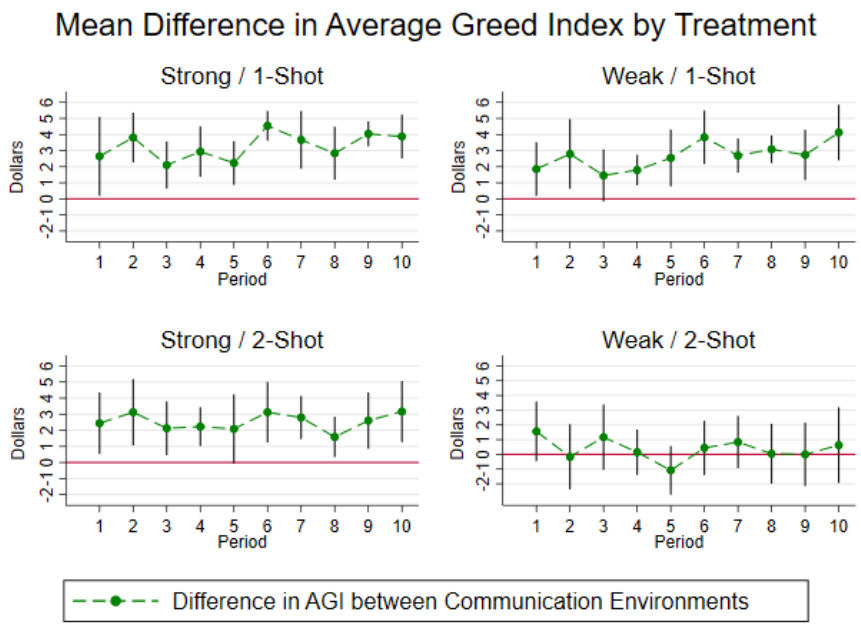

Figure 4b: The mean difference in AGI between digital and face-to-face bargaining by period and treatment. We include 95% confidence intervals.

We can now turn our attention to Figure 5. The four panels of this figure show the proportion of efficient decisions and corresponding payoff distributions (in terms of proportions) for each of our eight treatments. Notice that behavior is most similar across environments in our weak property rights, two-shot bargaining sessions. This is true of both efficiency and payoff distributions. In fact, the per-period average earnings of Controllers and Bargainers across environments in this treatment are statistically indistinguishable.

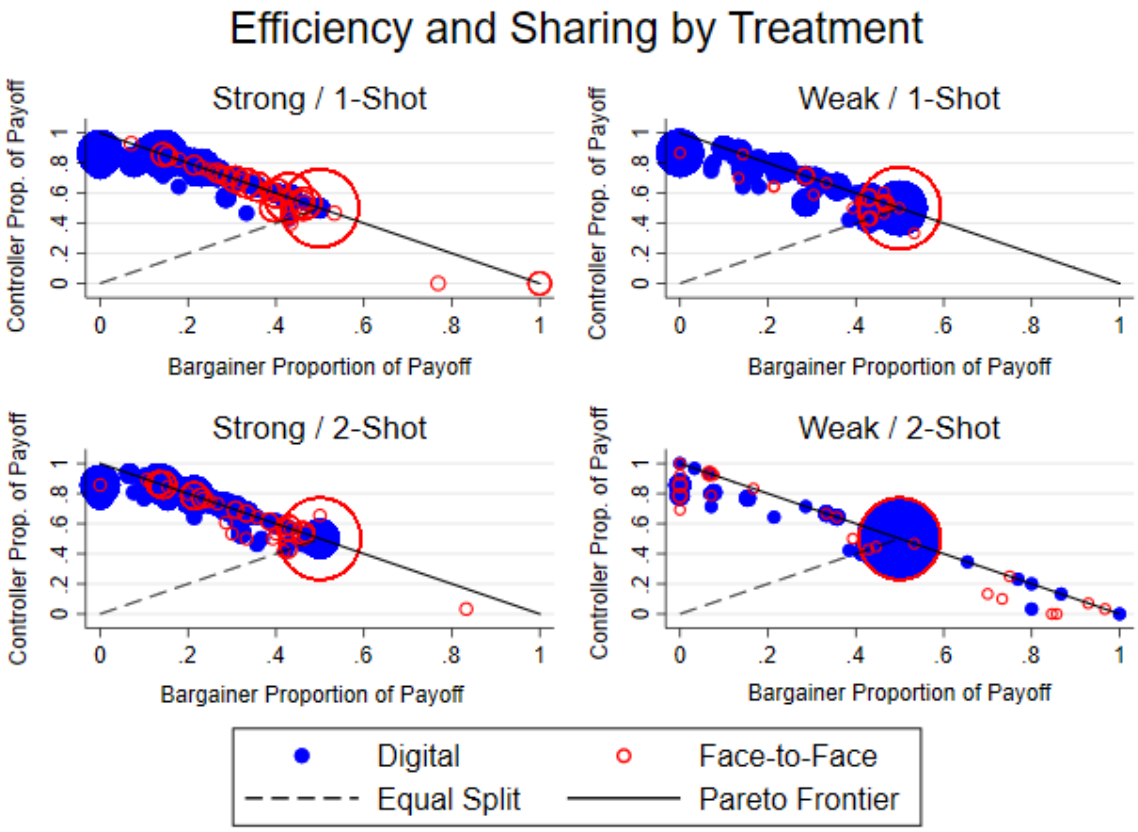

Figure 5: The proportion of efficient decisions and corresponding payoff distributions (in terms of proportions of total payoff) for each of our eight treatments. The data used in this figure include all 960 observations across all 10 periods of bargaining from both communication environments.

Removing the strategic considerations of repeated bargaining or using strong property rights both cause a large and highly significant reduction in average Bargainer earnings in digital sessions but have a relatively small and weakly significant impact in the face-to-face environment. Each change compels

Controllers in digital sessions to behave in a strongly self-regarding manner. This finding aligns with the notion that Controllers in these treatments, regardless of environment, may desire to behave in a self-regarding manner, but do not do so in a face-to-face setting as this desire is dampened by a concern for the other player's payoff, or by desires to avoid uncomfortable interpersonal interaction in the face-to-face setting.

If, for example, the high level of other-regarding behavior observed in the face-to-face setting was truly driven by other-regarding preferences, then we would not expect to see such a drastic shift in payoff distributions as a result of migrating our bargaining experiment to a digital environment. We see then in the weak property rights, two-shot bargaining sessions, where both strategic concerns and moral ambiguity persist, that other-regarding behavior is invariant to the differences in our two environments.

Table 8 reports aggregate summaries on the number and proportion of sharing allocations achieved in each of our four treatment types in face-to-face and digital environments. We find that the communication environment itself impacts sharing.

Table 8. Sharing Outcomes.

	Face-to-Face		**Digital**		**Fisher's Exact Test (Facet-to-Face vs. Digital)**
Strong, 1-shot	*N*	120	*N*	120	
	Sharing	54 (.45)	*Sharing*	5 (.04)	$p < 0.001$
Strong, 2-shot	*N*	120	*N*	120	
	Sharing	70 (.60)	*Sharing*	12 (.10)	$p < 0.001$
Weak, 1-shot	*N*	120	*N*	120	
	Sharing	103 (.87)	*Sharing*	36 (.30)	$p < 0.001$
Weak, 2-shot	*N*	120	*N*	120	
	Sharing	97 (.81)	*Sharing*	88 (.73)	$p = 0.219$
Total	*N*	480	*N*	480	
	Sharing	324 (.68)	*Sharing*	141 (.29)	$p < 0.001$

Notes: The leftmost column indicates the property rights assignment mechanism used. The top row of each property rights assignment panel indicates the total number of decisions made across face-to-café and digital sessions. Below

the number of decisions made, we present the total number of decisions where a sharing division of the available surplus was realized and in parentheses the proportion of the total number of decisions that this constitutes.

Proportions testing shows that sharing for three of our four treatment types is significantly lower in the digital environment than in the face-to-face environment (using Fisher's exact tests). 68 percent of the face-to-face and 29 percent of the digital pairs choose sharing allocations ($p < 0.001$, Fisher's exact test).

Introducing ambiguity and removing the threat of interpersonal conflict reveals to us that what HS and Harrison and McKee (1985) identified as other-regarding behavior is perhaps instead a sort of self-regarding behavior motivated by a desire to avoid interpersonal conflict, including psychological and confrontation costs such as awkwardness, embarrassment, or guilt (Jindal and Newberry 2018; Gago 2019). Note that moving in any direction away from the weak property rights, two-shot sessions causes a drastic and highly significant reduction in average Bargainer earnings.

4.2.3 Experience

Controllers in our digital setting are more likely to engage in unilateral decisions (Table 9). Also, we see that Bargainers in the digital setting initially expect Controllers to agree to equitable allocations but modify this as they gain bargaining experience (Table 10).

Table 9: Instances of Unilateral Maximization.

Treatment	Digital	Face-to-Face
Strong, 1-Shot	67.5%	6.7%
Strong, 2-Shot	59%	19.2%
Weak, 1-Shot	42.5%	1.7%
Weak, 2-Shot	12.5%	9.2%

Notes: Instances of Unilateral Maximization. This table reports the percentage of bargaining interactions where Controllers unilaterally maximize earnings. Differences in proportions are all highly significant across environments ($p < .001$) except for the weak property rights, two-shot bargaining treatments ($p \approx .41$).

We take this as suggestive evidence that the increased efficiency in later bargaining periods in our digital setting results primarily from a change in Bargainers behavior. Because Controllers in this environment do not face the same interpersonal pressure during negotiations faced by Controllers in the face-to-face

environment, they more often deny disadvantageous deals they may have otherwise accepted if bargaining face-to-face.

Table 10: Requested Vs. Actual Sacrifice Rates

Period	1	2	3	4	5	6	7	8	9	10
Requested Average Sacrifice	.62	.47	.38	.39	.40	.37	.26	.30	.24	.24
Actual Average Sacrifice	.21	.21	.18	.18	.22	.16	.12	.11	.16	.17
Unilateral Decisions	16	12	9	9	7	11	5	13	8	10

Notes: Sacrifice Rates. Let S be Sacrifice, U be the unilateral maximum amount available to a Controller, and B be the payoff to the Controller conditional on accepting a Bargainer's proposal. Then we define the following measure, S = $\frac{U-B}{U}$, which represents the percentage of her earnings that result from unilateral maximization she would sacrifice by accepting the proposal.

Though the effect of anonymity on self-regarding behavior is well documented, this would be the first time, to our knowledge, that an experiment has documented the impact of anonymity on efficiency in this sort of bargaining environment.

5 Practical Implications

Despite evidence of learning, we find persistent differences in the ability of subjects to find gains from trade when completing a simple negotiation task in digital and face-to-face settings. We also show that subjects take advantage of minimal guilt or social-norm repercussions during digital negotiations and distribute surplus less equally than in a face-to-face setting. We believe these findings have important practical implications for settings in which the ability to complete coordinated tasks is a function of skilled communication and in markets where impersonal negotiations increasingly occur.

First, the transition to digital bargaining emboldens Controllers to be more rigid in their bargaining positions, more often denying propositions that involve high sacrifice rates and also engaging in unilateral maximization (Tables 9 and 10). This places the onus on Bargainers to either fully internalize the Controller's property rights when formulating a proposition or receive no payoff. Our results may be applicable outside simple negotiation settings. For example, DellaVigna et al. (2012) shows that

individuals prefer not to give to charitable causes, but dislike saying no. Coupled with our findings, this suggests that charitable campaigns might be more successful if they avoid impersonal outreach media like email or texts.[22]

Second, our results also suggest that face-to-face interactions may lead to more successful dispute resolution. For example, this finding might relate to settings of legal arbitration like divorce where parties negotiate over resource allocation and child custody. The sudden increase in the role of telecommunications in this process may lead to an increase in failure rates and in outcomes that more heavily favor the party who has perceived bargaining power. Reducing interpersonal interaction could increase the frequency of bargaining delays and lead to costly litigation (Fenn and Rickman 1999; Hubbard 2018). Similarly, firms should work to reduce social distance among team members whenever teams do not work face-to-face. This may help with task allocation, productivity, and intra-team dispute resolution.[23]

Third, digital bargaining may dampen information flow thereby increasing the difficulty of 'type detection', which is the ability to assess your counterpart's disposition (i.e., cooperative vs. non-cooperative, friendly vs. not friendly, etc.). This ability to type detect is a primary driver in cooperative decision-making in social dilemmas (He et al. 2017).

Finally, we see that the efficiency gap in our experiment does not close in most settings. This likely occurs because Bargainers do not sufficiently adjust their approach to bargaining or expectations about allocations. Some research shows that using mediators or negotiation assistants can improve bargaining outcomes in situations where simple bargaining heuristics tend to fail (Nunamaker et al. 1991; Babcock and Loewenstein 1997; Rangaswamy and Shell 1997; Larsen et al. 2020). Thus, using mediators

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[22] One potential exception is that some people may prefer the veil of the screen in certain negotiation settings. For example, evidence from Leibbrandt and List (2015) show that in a setting with minimal social interaction between employers and job applicants, women are just as likely as men to apply and enter wage negotiations when there is an explicit mention that the "wage is negotiable" in the application description. Further, digital negotiations may appeal to individuals who are more text savvy, adept at social judgment, and effective at screening conversations, which Babin (2018) suggests women are best at.

[23] For example, Greiner, Caravella, and Roth (2014) find that cooperativeness in Ultimatum Game experiments is as high in Second Life (a virtual world setting) as it is in a laboratory setting featuring pre-decision, face-to-face communication.

or negotiation assistants might improve outcomes in real-world settings that mimic our digital one-shot and strong-property-rights bargaining settings.

6 Conclusion

This paper contributes to the literature on the Coase theorem and extends some of the seminal works studying it in the experimental laboratory (Hoffman and Spitzer 1982, 1985). Our experiment tests the Coase theorem using a 2x2x2, between-subjects design that varied the method of assigning property rights, whether subjects engaged in repeated bargaining, and whether subjects bargained face-to-face or in a digital environment. As did HS, we either reinforced property rights with entitlement priming (strong property rights) or instead used neutral language (weak property rights) to further sharpen the notion of property rights in our strong property rights treatments.

Our results are consistent with several key findings from the early work of HS: subjects often choose the efficient allocation when bargaining, efficiency is equivalently high for one- and two-shot bargaining, and efficiency is invariant to the strength of property rights. We also find that weak property rights produce equitable allocations whereas strong property rights produce self-regarding behavior. However, when using comparable data, we do not replicate the finding from HS (1982) that one-shot bargaining produces more self-regarding behavior than does two-shot bargaining.[24]

We find in the digital setting that subjects choose efficient allocations significantly less often than do subjects who bargain face-to-face, conditional on subjects bargaining with strong property rights and/or in one-shot bargaining treatments. Subjects engaging in two-shot bargaining with weak property rights converge to similar behaviors (in terms of efficiency and payoff distributions) in both environments. Additionally, we find that subjects greatly improve their ability to achieve efficient bargaining outcomes with practice in both environments. This learning occurs at about the same rate in both environments and tapers out at about the same time in both environments. This suggests digital negotiation may be okay in settings where there is a repeated relationship with symmetric bargaining positions. However, if

[24] We cannot rule out that this is driven by a tit-for-tat strategy.

negotiations stray from this along either dimension then it might be better to interact in person or at least use communication media that foster more personal interaction.

Differences in both allocations and efficiency that arise between the face-to-face and digital settings are likely due to the increased degree of anonymity, social distance, loss of interpersonal connection, and loss of social cues in the digital setting. Given that efficiency and other-regarding behavior are not invariant to the negotiating environment, these results suggest that Coase's theorem may require additional behavioral considerations; in particular, the theorem may lack predictive power whenever negotiations occur under the veil of anonymity.

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Appendix: "Behind the Screens: Does the Coase Theorem Hold Online?"

A. Face-to-Face Sessions

A.1 Matching Protocols

Our bargaining partner matching method for each session proceeded as follows. First, after all 12 subjects arrived, each subject was handed a unique identification card that was drawn from a bag without replacement. These cards, numbered 1-12, had been pre-assigned to 6 bargaining stations that were set up within the experimental laboratory (one odd and one even card was randomly assigned to each station). Second, subjects with odd-numbered cards were instructed to enter the experimental laboratory and find the station associated with their card. Subjects with even-numbered cards sat to wait until they were instructed to enter the laboratory and find the station associated with their card. No talking was allowed during any of this time. Third, in the two-shot sessions, the 6 subjects who entered the laboratory and got seated first were the "stationary" bargainers and stayed at that station for the duration of the session. The other 6 who entered and got seated second were the "movers," and were instructed to rotate clockwise to the next bargaining station after all pairs finished making two decisions. Subjects in these sessions bargained 10 times with a total of 5 different partners. A similar structure was used for the one-shot sessions, except after each period all subjects stood up and moved to the back of the room, and then each station was given a new randomly assigned pair of unique identification numbers and subjects were then instructed to sit at the station with their number. Subjects in these sessions bargained 10 times with a total of 10 different partners.

A.2 Instructions: *Strong* Property Rights, 1-Shot [2-Shot]

You are here today to participate in a simple economic study that will require you to make a series of ten decisions total with [10 different partners (1 decision with each partner)] [5 different partners (2 decisions with each partner)]. Each of you randomly selected a number when entering the lab today. This number will function as your identity for the duration of this experiment. We have generated a list of random number matches that we will use to assign partners to each of you today throughout the experiment. When we begin the experiment, and before each period of play, we will have all participants stand and wait quietly at the back of the lab. Our staff will then match you into pre-designated, randomly generated number pairs.

At the start of each decision-making period, you and your partner will play the Hash Mark Game. This game works as follows: there will be N hash marks in a row. During your turn, you can cross out from 1 to Y hash marks. That is, you can cross out 1,2,3, …, Y hash marks. Whoever crosses out the last hash mark loses the hash mark game. Remember, a player must always cross out at least one hash mark during his or her turn but can never cross out more than Y hash marks during a turn. In odd-numbered periods, the player with the *lower* identity number will have the first move in the game, and in even-numbered periods, the player with the *higher* identity number will move first. We give an example of this game below, where we suppose that N = 5 and Y =2.

At the start of the game, before either you or your partner has moved, you will see:

/ / / / /

Now, suppose that whoever plays first marks out two hash marks:

~~/ /~~ / / /

And that the second player now marks out two hash marks:

~~/ / / /~~ /

Now, we can see that whoever played first must now cross out the last hash mark and therefore loses the game.

Whichever player wins the hash mark game **earns the right** to be the 'Controller' for that decision period. Whoever is the Controller for a given decision period can unilaterally choose a number that corresponds to an allocation from a payoff table that assigns payoffs to both players. The Controller may entertain offers from his/her partner (the Bargainer) who may attempt to persuade the Controller to select a different allocation from the payoff table. Either player may agree to transfer money to the other player to facilitate bargaining.

Once you and your partner finish making a decision, please raise your hand. An experimenter will collect your decision form for that period and ask that you wait quietly until all 6 pairs are finished. Once every pair has finished making a decision the period is over. We will instruct everyone to stand up and go wait along the back wall again, and we will announce everyone's new partner and station to sit at for the next period. We will then provide a new hash mark game to determine the property rights for the next period with your new partner. We will also provide a new decision form for the next period.

Payment

After all 10 periods have been completed, we will randomly select 2 periods, and you will be paid in cash for those 2 periods. We will place cards numbered 1-10 ten into a bag and randomly select 2 cards from the bag. The numbers on the selected cards represent the periods for which you will be paid. You will be paid for both decisions from the selected periods, and a $10 show up fee.

Once we complete the experiment, we ask that each of you complete a short survey. After completing the survey, we will provide instructions about where and how to receive your payment.

Example of payoff tables and bargaining:

What follows is a simplified version of today's experiment. This is meant as an exercise to help ensure that each participant understands the structure of today's game. Please raise your hand at any time if you have questions. It is important that you understand how this game is played so that you can earn as much money as possible.

Example payoff table:

Number	Payoff to A	Payoff to B
1	$4	$1
2	$5	$2
3	$3	$5

In this example, if the number 2 is chosen, A would receive a payoff of $5 and B would receive $2.

Here is the way you will pick the number. Two people will participate on each decision. After playing the hash mark game, one of you will have **earned the right** to be Controller for that period. The Controller can choose a number from the payoff table without agreement or input from the other player. If the Controller decides to make a unilateral decision, they should report this choice on the form provided and turn it in. Alternatively, a pair of participants may reach a joint agreement about the number to be chosen. The person who is *not* the Controller (i.e. the Bargainer) may try to influence the Controller to decide on a more favorable number by agreeing to pay the Controller some or all of his/her earnings associated with a particular number. If a pair of participants reaches a mutual decision, both participants should sign the form and indicate any money to be paid from one player to the other. Here are two examples of how this works.

Example 1: Suppose B is the Controller and B chooses number 3. B would fill out the form and turn it in. B earns 5 and A earns 3.

Example 2: Suppose A is the Controller. A and B could agree to set the number at 3 with B making a payment of 2 to A. A and B would write this on the form and both would sign it. Then A would earn 5 and B would earn 3.

Are there any questions? If so, please raise your hand. Once the exercise starts please do not talk to anyone except for the person you are paired with. Remember, you will make one decision with each of your partners. You will play this game with ten partners.

Quiz
To check your understanding please answer the following questions about the example Payoff Table below [see Appendix A.3 for the extra example payoff table and example agreement form used in all face-to-face instructions]. For each question, assume you are player A. When you are finished, please raise your hand and one of our staff members will go and check your answers at your station.

1. Number _____ makes me the most money. Number _____ makes me the least money.

2. If I become Controller, I can make $_____ even if the other person doesn't agree.

3. If both players reach a joint decision to choose number 4 and B pays me $2.00, I make $_____.

4. If I am the Controller, I may choose the number that corresponds to my maximum payoff without making a joint agreement with the other person TRUE or FALSE? _____.

A.3 Instructions: *Weak* Property Rights, 1-Shot [2-Shot]

You are here today to participate in a simple economic study that will require you to make a series of 10 decisions total with [10 different partners (1 decision with each partner)] [5 different partners (2 decisions with each partner)]. Each of you randomly selected a number when entering the lab today. This number will function as your identity for the duration of this experiment. We have generated a list of random number matches that we will use to assign partners to each of you today throughout the experiment. When we begin the experiment today, and before each period of play, we will have all participants stand and wait quietly at the back of the lab. Our staff will then match you into pre-designated, randomly generated number pairs.

At the start of each decision-making period, an experimenter will flip a coin. If the coin lands on heads, the subject with the lowest of the pair's identification numbers will have the property rights. If it lands on tails, the person with the highest number will have the property rights. We call this person with the property rights the Controller. Whoever is the Controller for a given decision period will have the ability to unilaterally choose a number that corresponds to an allocation from a payoff table that assigns payoffs to both players. The Controller may entertain offers from his/her partner (the Bargainer) who may attempt to persuade the controller to select a different allocation from the payoff table. Either player may agree to transfer money to the other player to facilitate bargaining.

Once you and your partner finish making a decision, please raise your hand. An experimenter will collect your decision form for that period and ask that you wait quietly until all 6 pairs are finished. Once every pair has finished making a decision the period is over. We will instruct everyone to stand up and go wait along the back wall again, and we will announce everyone's new partner and station to sit at for the next period. We will then provide a new decision form and flip the coin again to reassign property rights for the next period with your new partner. period.

Payment

After all 10 periods have been completed, we will randomly select 2 periods, and you will be paid in cash for those 2 periods. We will place cards numbered 1-10 into a bag and randomly select 2 cards from the bag. The numbers on the selected cards represent the periods for which you will be paid. You will be paid for both decisions from the selected periods, and a $10 show-up fee.

Once we complete the experiment, we ask that each of you complete a short survey. After completing the survey, we will provide instructions about where and how to receive your payment.

What follows is a simplified version of today's experiment. This is meant as an exercise to help ensure that each participant understands the structure of today's game. Please raise your hand at any time if you have questions. It is important that you understand how this game is played so that you can earn as much money as possible.

<u>Example payoff table</u>:

Number	Payoff to A	Payoff to B
1	$4	$1
2	$5	$2
3	$3	$5

In this example, if the number 2 is chosen, A would receive a payoff of $5 and B would receive $2.

Here is the way you will pick the number. Two people will participate on each decision. One of you has been randomly assigned the role of Controller. The Controller can choose a number from the payoff table without agreement or input from the other player. If the Controller decides to make a unilateral decision, they should report this choice on the form provided and turn it in. Alternatively, a pair of participants may reach a joint agreement about the number to be chosen. The person who is *not* the Controller (i.e. the Bargainer) may try to influence the Controller to decide on a more favorable number by agreeing to pay the Controller some or all of his/her earnings associated with a particular number. If a pair of participants reaches a mutual decision, both participants should sign the form and indicate any money to be paid from one player to the other. Here are two examples of how this works.

Example 1: Suppose B is the Controller and B chooses number 3. B would fill out the form and turn it in. B earns 5 and A earns 3.

Example 2: Suppose A is the Controller. A and B could agree to set the number at 3 with B making a payment of 2 to A. A and B would write this on the form and both would sign it. Then A would earn 5 and B would earn 3.

Are there any questions? If so, please raise your hand. Once the exercise starts please do not talk to anyone except for the person you are paired with. Remember, you will make one decision with each of your partners. You will play this game with ten partners.

Quiz
To check your understanding please answer the following questions about the example Payoff Table below [see Appendix A.3 for the extra example payoff table and example agreement form used in all face-to-face instructions]. For each question, assume you are player A. When you are finished, please raise your hand and one of our staff members will go and check your answers at your station.

1. Number _____ makes me the most money. Number _____ makes me the least money.

2. If I become Controller, I can make $_____ even if the other person doesn't agree.

3. If both players reach a joint decision to choose number 4 and B pays me $2.00, I make $_____.

4. If I am the Controller, I may choose the number that corresponds to my maximum payoff without making a joint agreement with the other person TRUE or FALSE? _____.

A.4 Agreement Form: All Face-to-Face Sessions

Payoff Table

Number	Controller	Bargainer
1	0.00	12.00
2	2.00	10.50
3	3.00	11.00
4	5.50	6.50
5	7.00	5.50
6	9.00	3.00
7	12.00	0.00

Player _____ is the Controller for this decision period (please use your assigned number)

Player _____ is ***not*** the Controller for this decision period (please use your assigned number)

Controller: enter your decision here if you do not reach a mutual agreement with your partner.

Controller's Decision (If Applicable)

Number Chosen _____

Signed _____ (Controller)

Both players: use this section if you have reached a mutual agreement.

Joint Agreement

Number Chosen _____

$_____ to be paid from _____ to _____

Signed _____ (Controller)

Signed _____ (Respondent)

B. Digital Bargaining Sessions

B.1 Instructions: *Strong* Property Rights, 1-Shot

You are here today to participate in a simple economic study that will require you to make a series of 10 decisions total with 10 different partners (1 decision with each partner). Each of you is already situated at a computer station; you will remain at this computer station for the duration of the experiment. Our program will randomly match you with a new partner at the start of each period.

When we begin, we will assign each of you a letter that will serve as your identity for the duration of this experiment. We do this so that you can easily verify that you are matched with a new partner for each period of negotiations.

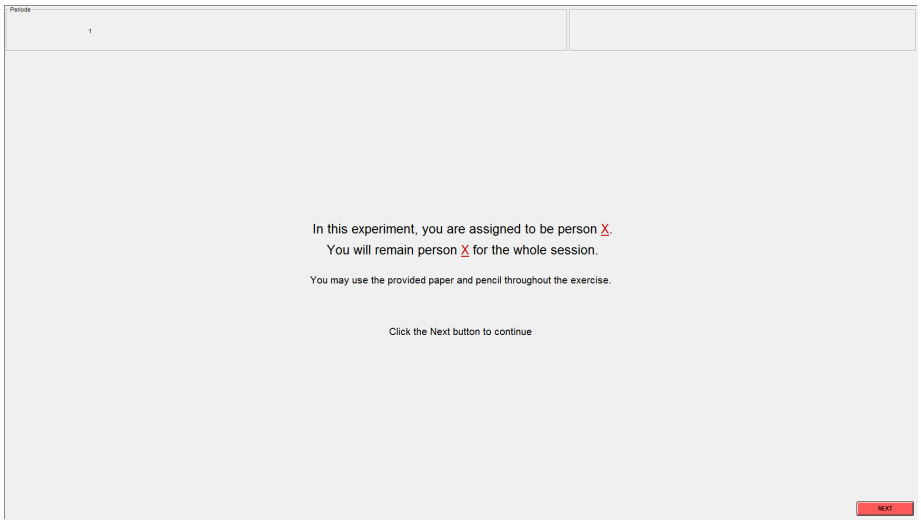

Figure 1. Example of the identity assignment screen

At the start of each period, we will randomly pair you with another player:

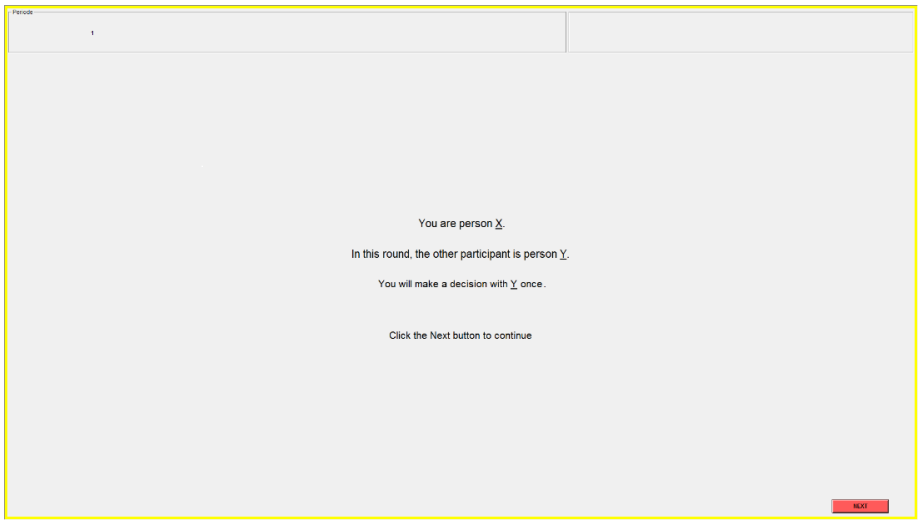

Figure 2. Example of the partner assignment screen

To begin the decision-making period with this player, you will both answer a series of three math questions. Whoever answers all three questions correctly in the shortest amount of time will **earn the right** to dictate how much money both partners earn for that period. We call this person who wins the math game the 'Controller'.

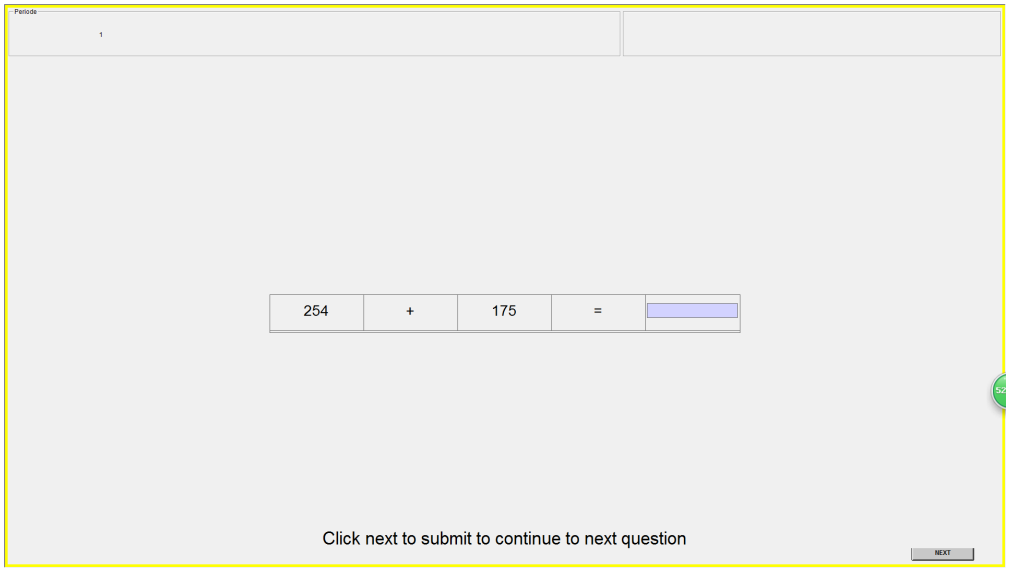

Figure 3. Example of a question from the math game

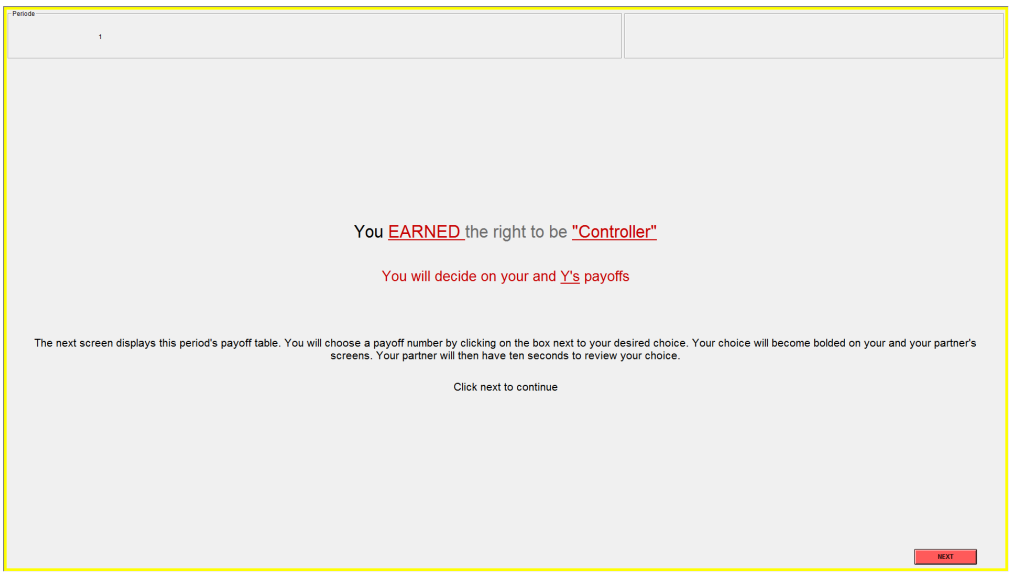

Figure 4. Example of the role assignment screen. This shows you whether you are the Bargainer or the Controller.

Whoever is the Controller for a given decision period will choose a number from a payoff table (see Figure 5) that assigns payoffs to both players. This number is selected without agreement or input from the other player. After the Controller chooses a payoff, his/her partner, termed the 'Bargainer', will have a period of time to review the Controller's decision before both players progress to the bargaining stage.

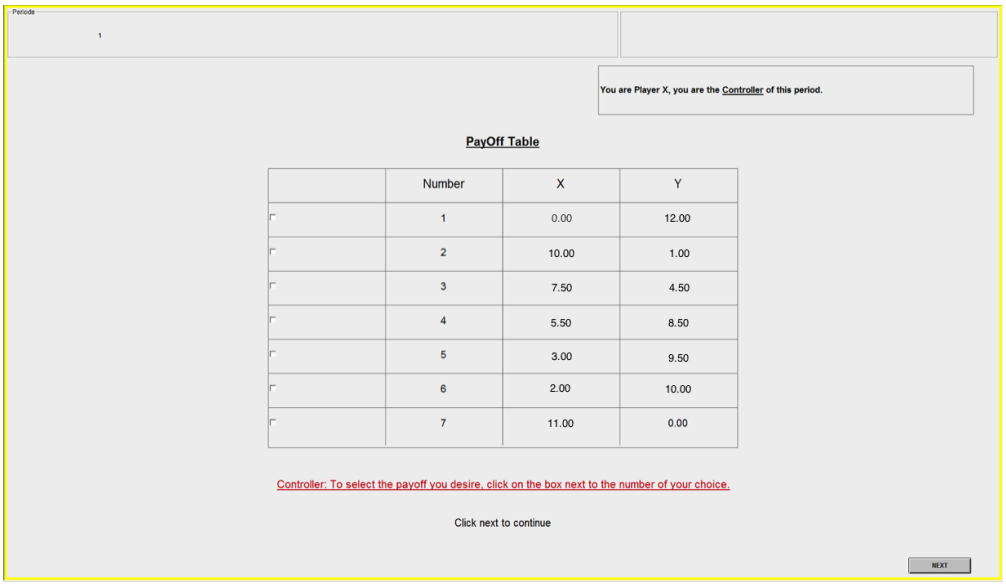

Figure 5. Example screen where Controller can select payoffs for both players. You will select a payoff by clicking on any one of the check boxes in the leftmost column.

During the bargaining stage, the Controller and Bargainer may attempt to jointly agree upon a new allocation by communicating via the provided chat box. Either the Bargainer or the Controller can offer/ agree to transfer all or some of their earnings (under payoffs from the new allocation) to the other player as part of this new agreement.

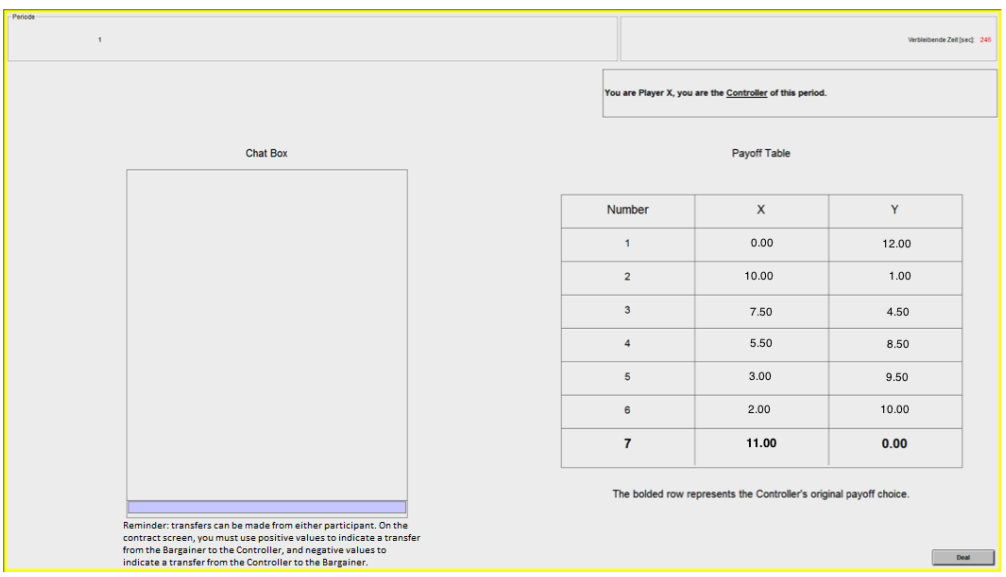

Figure 6. Example of the bargaining stage. Notice the 'Deal' button in the bottom right-hand corner.

The bargaining stage will last for a maximum of 180 seconds. If you and your partner negotiate a new deal, both players can click on the 'Deal' button in the bottom right corner of the screen to proceed. If either of the two players does not click the deal button, the period ends and both players receive payoffs corresponding to the Controller's original decision. For example: if the Controller is uninterested in negotiating a new deal, then he/she can wait for the 180 seconds to pass without clicking the 'Deal'

button, which will cause the period to end and both players will receive payoffs corresponding to the Controller's original decision.

If both players click the deal button, the period proceeds to the next stage, where the Bargainer will create a contract consisting of the **newly chosen payoff number** and **any agreed upon money transfer**.

Please note that negative values will represent a transfer of money from the Controller to the Bargainer.

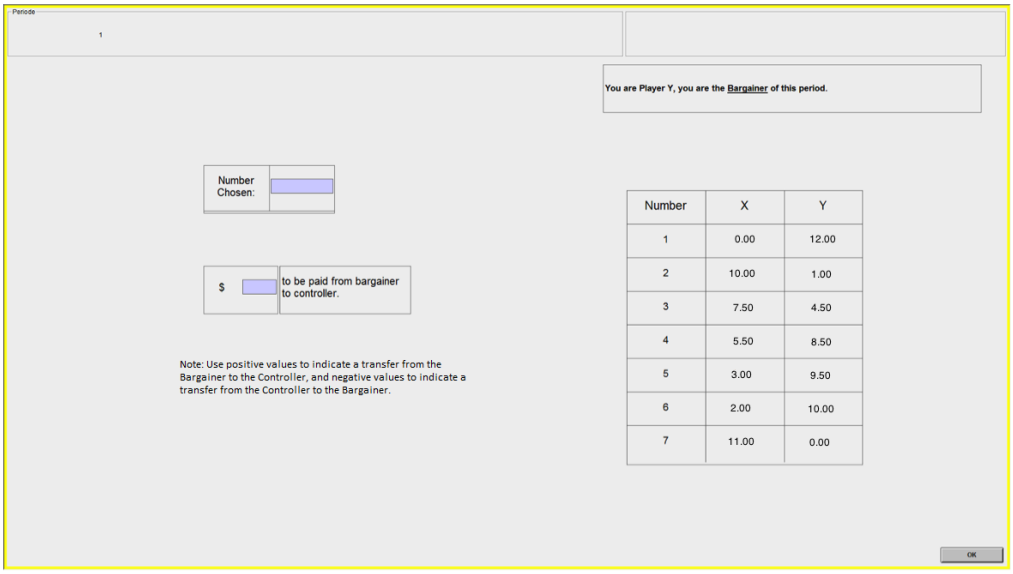

Figure 7. Example of the contract screen. Only the Bargainer will view this screen.

The Bargainer will submit this contract to the Controller by clicking 'Ok'.

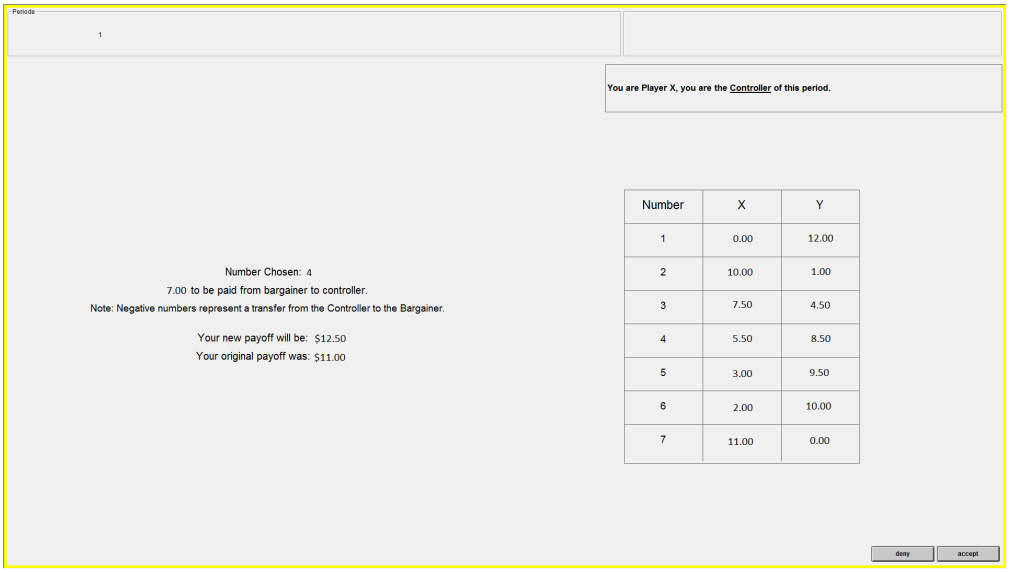

Figure 8. Example of the contract proposal that the Controller will see.

The Controller may either click 'Accept' to accept the contract or 'Deny' to deny the contract. Clicking 'Accept' will implement the new agreement and each player will receive payoffs corresponding to the

contract. Clicking ‘Deny’ will cancel the new contract and each player will receive payoffs corresponding to the allocation originally chosen by the Controller.

A period can thus end in any of the following ways:

- Either player does not click the ‘Deal’ button during the bargaining stage. In this case, payoffs from the Controller’s original choice prevail.
- Both players click ‘Deal’ during the bargaining stage and the Controller clicks ‘Deny’ to deny the contract offered by the Bargainer. In this case, payoffs from the Controller’s original choice prevail.
- Both players click ‘Deal’ during the bargaining stage and the Controller clicks ‘Accept’ to accept the contract offered by the Bargainer. In this case, payoffs corresponding to the contract will prevail.

Once you and your partner complete your decision for that period, you will remain at a waiting screen until all other pairs have finished making a decision. Once all pairs have completed the decision period, the next period will begin with a new partner.

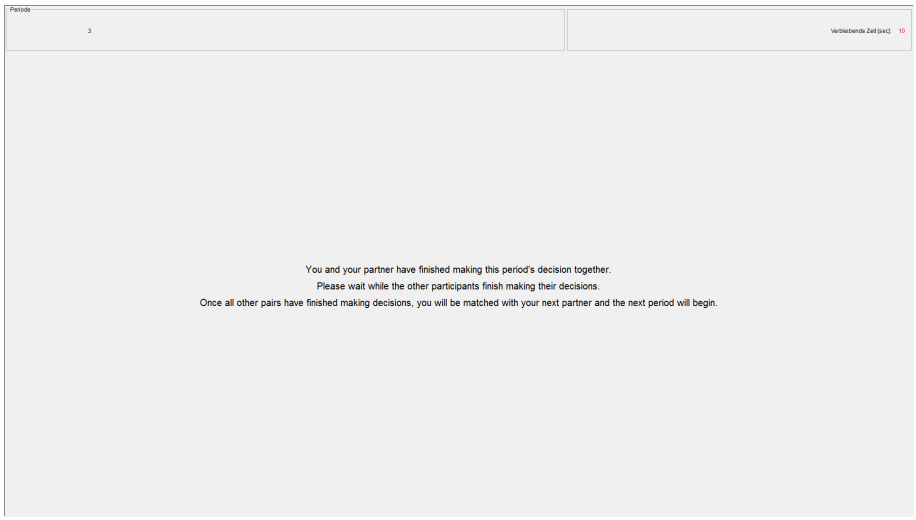

Figure 9. Example of the waiting screen.

Each period will proceed identically to the first. You will complete this process ten times (i.e., for 10 periods), each time with a new, randomly assigned partner.

Payment

Once you’ve completed all ten periods, our computer program will randomly choose two of the ten periods and we will pay you for the decision made in each of the two periods. Additionally, you will receive a $5.00 show-up fee. We will clearly display the periods for which we will pay you and provide a breakdown of your total payment.

Once we complete the experiment, we ask that each of you complete a short survey. After completing the survey, we will provide instructions about where and how to receive your payment.

Also notice that we've provided you with paper and pen. You may use this to assist you with your calculations during each math game and/or use it to record Controller decisions, new agreement terms and payoffs for each period. This is not mandatory and is only available as an aid.

What follows is a simplified version of today's instructions. This is meant as an exercise to help ensure that each participant understands the structure of today's experiment. Please raise your hand at any time if you have questions. It is important that you understand how this game is played so that you can earn as much money as possible.

Example payoff table:

Number	Payoff to A	Payoff to B
1	$4	$1
2	$5	$2
3	$3	$5

Example 1: If payoff number 2 is chosen, player A would receive a payoff of $5 and player B would receive a payoff of $2.

Example 2: Suppose player B is the Controller and chooses payoff number 3. Player A will have a chance to review this decision and then both players will proceed to the bargaining stage. Suppose player A cannot convince player B to change his decision. The game will end once the 180-second time limit expires. In this case, player B earns $5 for the period and player A earns $3 for the period.

Example 3: Suppose player A is the Controller and initially chooses payoff number 2. Player B will have a chance to review this decision and then both players will proceed to the bargaining stage. Suppose player B offers to transfer $2 to player A, conditional on player A agreeing to implement payoff number 3. Suppose player A agrees. Both players will click 'Deal' and then the Bargainer (here this is player B) will create a contract with the new terms. Player A accepts the terms. Now, player A earns $5 for this period and player B earns $3 for this period.

Are there any questions? If so, please raise your hand. Once the exercise starts, please do not speak to anyone except when using the chat box during the bargaining stage of each period. Remember, you will play this game with ten partners, and you will make one decision with each of them.

Quiz
To check your understanding please answer the following questions using the payoff table **below** these questions. For each question, assume you are player A. When you are finished, please raise your hand and one of our staff members will go and check your answers at your station.

1. Number _____ makes me the most money. Number _____ makes me the least money.

2. If I become Controller, I can make $_____ even if the other person doesn't agree.

3. If I reach a reach an agreement with B to choose number 4 and B agrees to pay me $2.00, I make $_____.

4. If I am the controller, I may choose the number that corresponds to my maximum payoff without making a joint agreement with the other person TRUE or FALSE? _____.

5. My partner and I have completed the first period. In the next period, I will make another decision with my same partner from the first period TRUE or FALSE _____.

6. If I am the Bargainer, I can input a negative value into the contract screen, which implies a transfer of money from the (Controller/Bargainer) to the (Controller/Bargainer)? _____ to the _____.

[Same example Payoff Table as in face-to-face sessions]

B.2 Instructions: *Weak* Property Rights, 2-Shot

You are here today to participate in a simple economic study that will require you to make a series of 10 decisions total with 5 different partners (2 decisions with each partner). Each of you is already situated at a computer station; you will remain at this computer station for the duration of the experiment. Our program will randomly match you with a new partner at the start of each round, which will consist of 2 decision periods with that same partner.

When we begin, we will assign each of you a letter that will serve as your identity for the duration of this experiment. We do this so that you can easily verify that you are matched with a new partner for each round of negotiations.

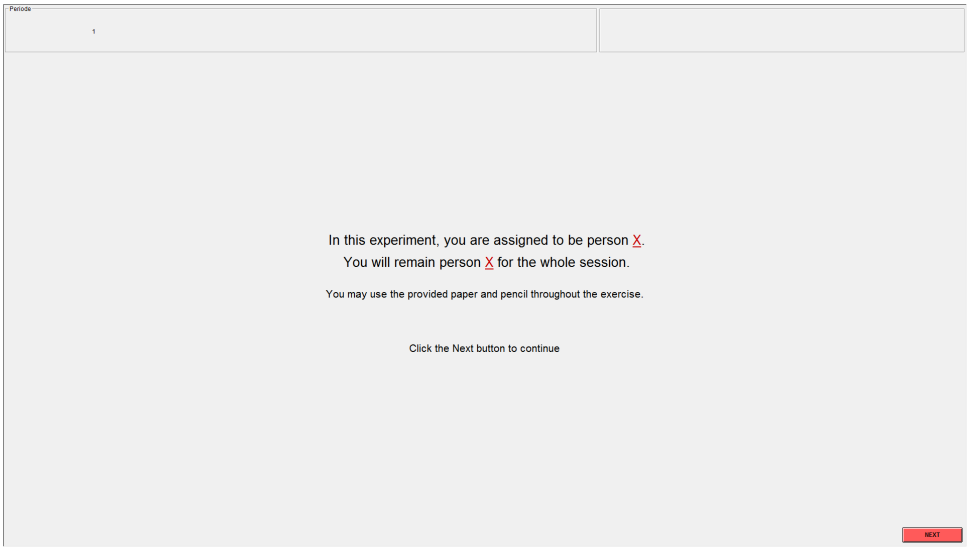

Figure 1. Example of the identity assignment screen

At the start of each round, we will randomly pair you with another player:

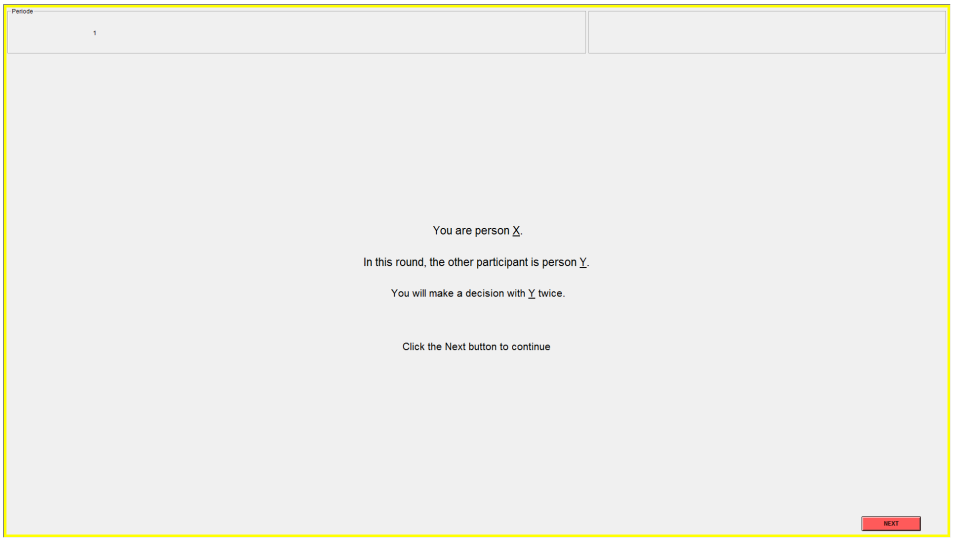

Figure 2. Example of the partner assignment screen

To begin your first decision making period with this player, you will both answer a series of three math questions. Whoever answers all three questions correctly in the shortest amount of time will **earn the right** to dictate how much money both partners earn for that period. We call this person who wins the math game the 'Controller'.

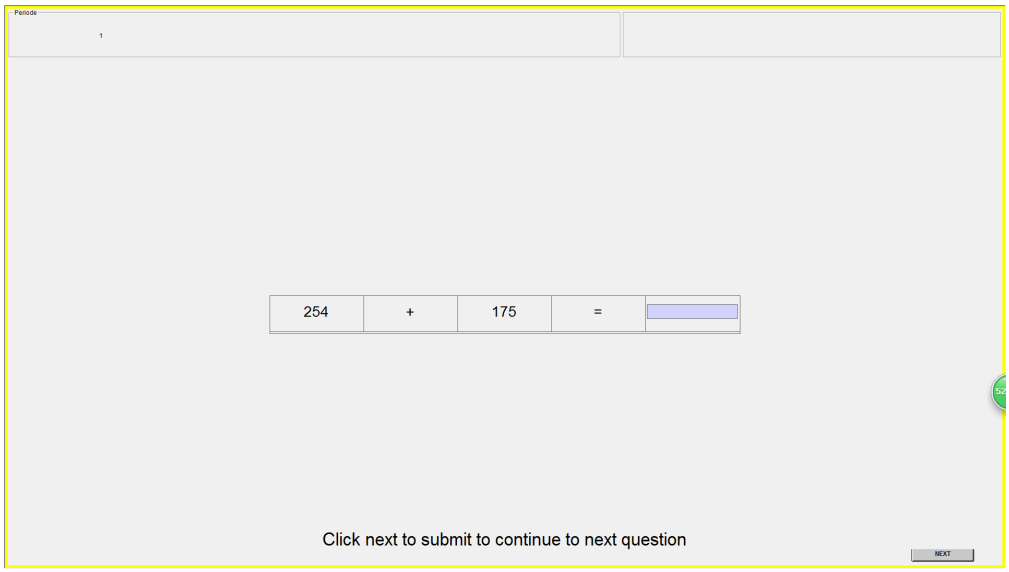

Figure 3. Example of a question from the math game

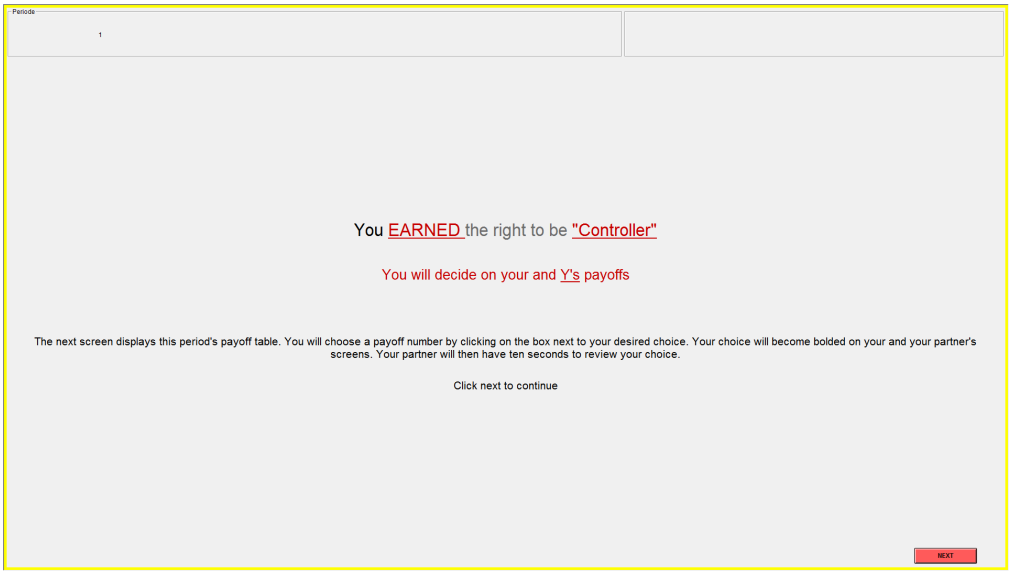

Figure 4. Example of the role assignment screen. This shows you whether you are the Bargainer or the Controller.

Whoever is the Controller for a given decision period will choose a number from a payoff table (see Figure 5) that assigns payoffs to both players. This number is selected without agreement or input from the other player. After the Controller chooses a payoff, his/her partner, termed the 'Bargainer', will have a period of time to review the Controller's decision before both players progress to the bargaining stage.

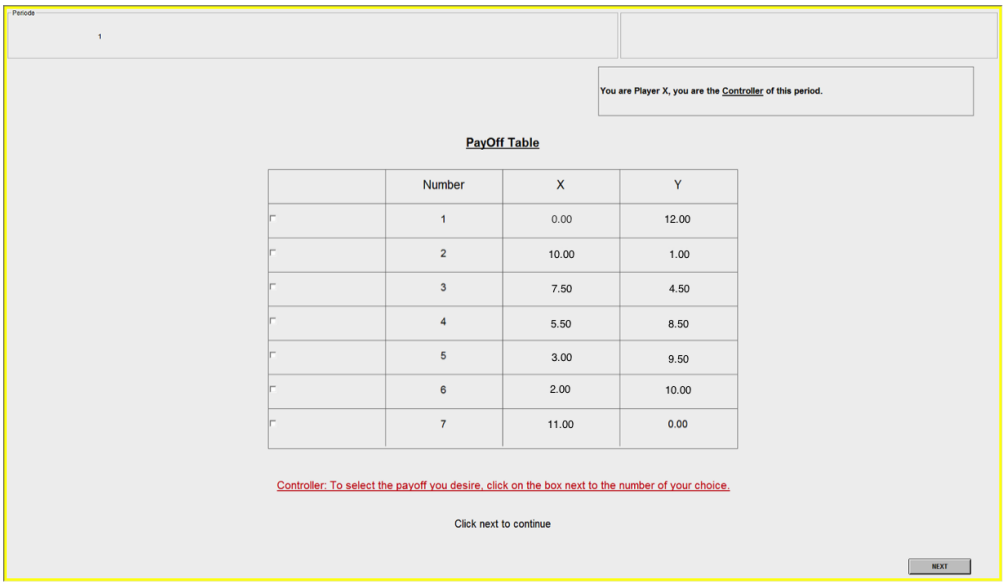

Figure 5. Example screen where Controller can select payoffs for both players. You will select a payoff by clicking on any one of the check boxes in the leftmost column.

During the bargaining stage, the Controller and Bargainer may attempt to jointly agree upon a new allocation by communicating via the provided chat box. Either the Bargainer or the Controller can offer/

agree to transfer all or some of their earnings (under payoffs from the new allocation) to the other player as part of this new agreement.

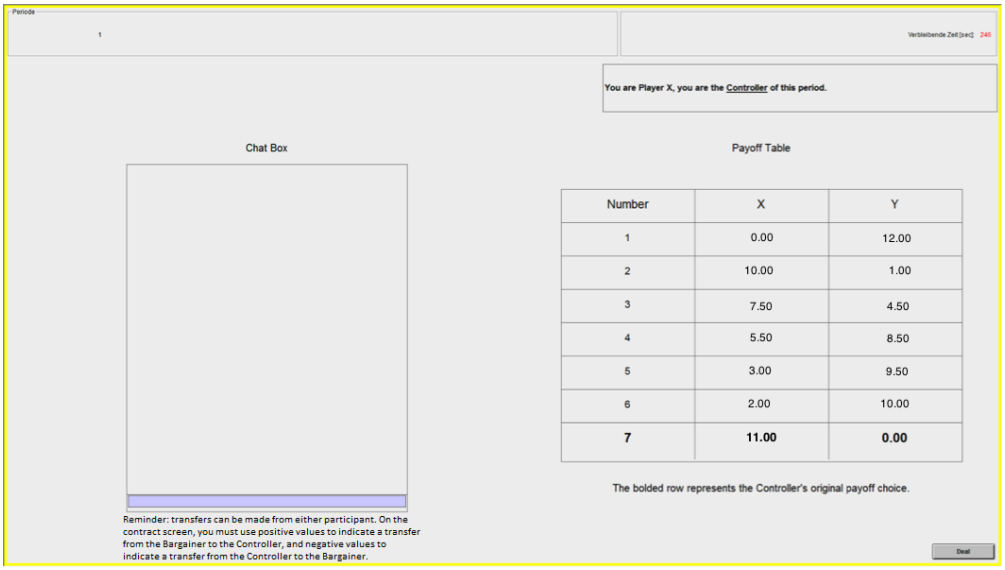

Figure 6. Example of the bargaining stage. Notice the 'Deal' button in the bottom right-hand corner.

The bargaining stage will last for a maximum of 180 seconds. If you and your partner negotiate a new deal, both players can click on the 'Deal' button in the bottom right corner of the screen to proceed. If either of the two players does not click the deal button, the period ends and both players receive payoffs corresponding to the Controller's original decision. For example: if the Controller is uninterested in negotiating a new deal, then he/she can wait for the 180 seconds to pass without clicking the 'Deal' button, which will cause the period to end and both players will receive payoffs corresponding to the Controller's original decision.

If both players click the deal button, the period proceeds to the next stage, where the Bargainer will create a contract consisting of the **newly chosen payoff number** and **any agreed upon money transfer**.

Please note that negative values will represent a transfer of money from the Controller to the Bargainer.

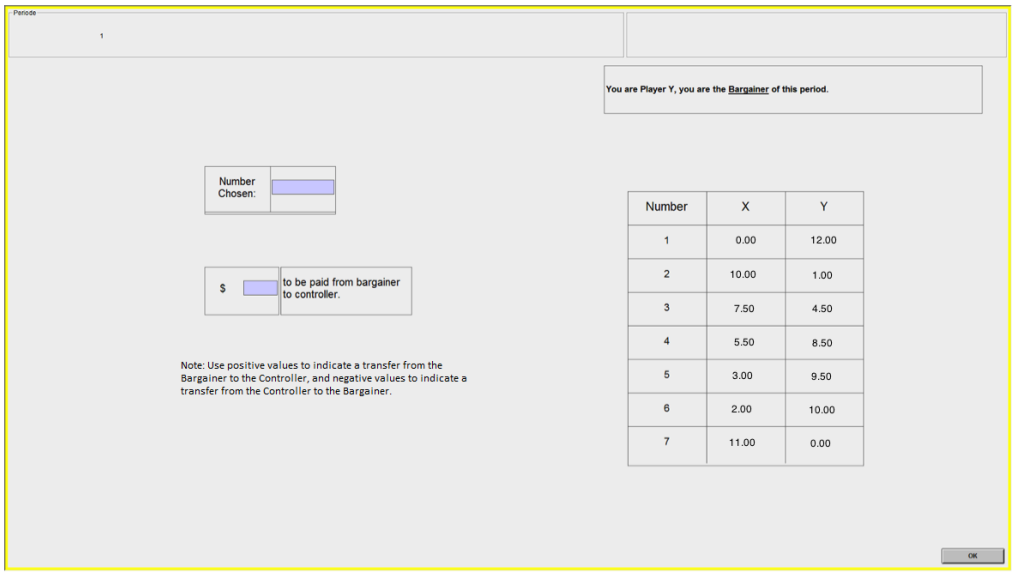

Figure 7. Example of the contract screen. Only the Bargainer will view this screen.

The Bargainer will submit this contract to the Controller by clicking 'Ok'.

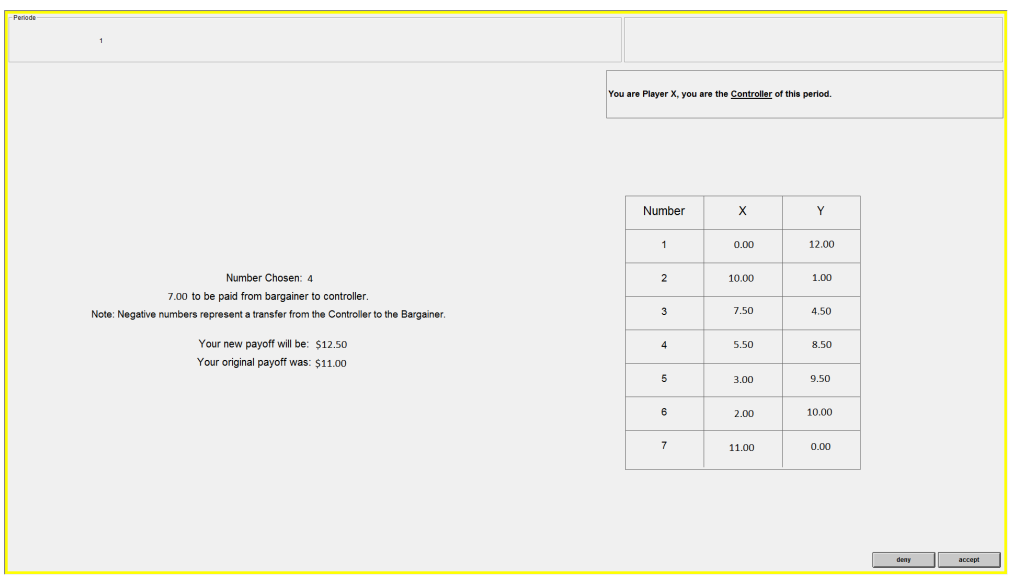

Figure 8. Example of the contract proposal that the Controller will see.

The Controller may either click 'Accept' to accept the contract or 'Deny' to deny the contract. Clicking 'Accept' will implement the new agreement and each player will receive payoffs corresponding to the contract. Clicking 'Deny' will cancel the new contract and each player will receive payoffs corresponding to the allocation originally chosen by the Controller.

A period can thus end in any of the following ways:

- Either player does not click the 'Deal' button during the bargaining stage. In this case, payoffs from the Controller's original choice prevail.

- Both players click ‘Deal’ during the bargaining stage and the Controller clicks ‘Deny’ to deny the contract offered by the Bargainer. In this case, payoffs from the Controller’s original choice prevail.
- Both players click ‘Deal’ during the bargaining stage and the Controller clicks ‘Accept’ to accept the contract offered by the Bargainer. In this case, payoffs corresponding to the contract will prevail.

Once you and your partner complete your first of two decision periods, you will remain at a waiting screen until all other pairs have finished making a decision. Once all pairs have completed the first decision period, the second of the round’s two decision periods will begin.

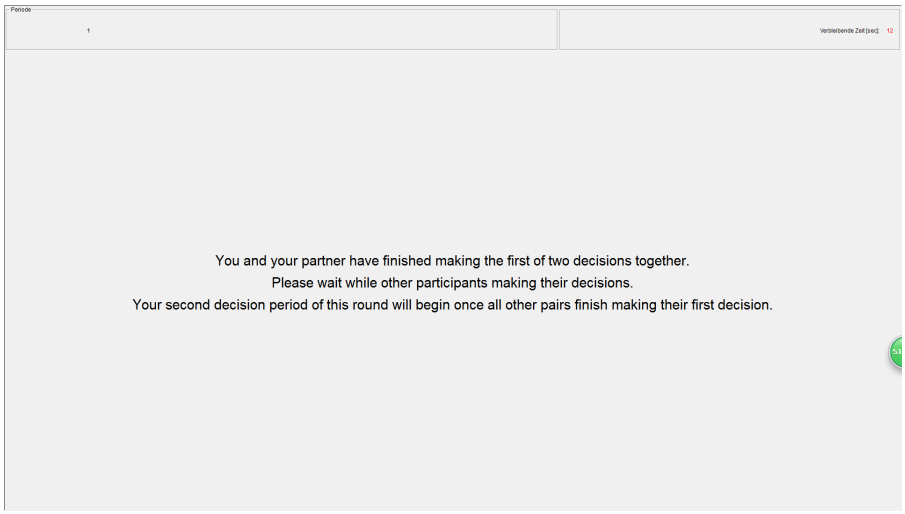

Figure 9. Example of the waiting screen.

This second period will proceed identically to the first. You will complete this two-period process five times (i.e. five rounds), each time with a new, randomly assigned partner.

Payment

Once you’ve completed all 5 rounds, our computer program will randomly choose one of the five rounds and we will pay you for both decisions you made during that round. Additionally, you will receive a $5.00 show-up fee. We will clearly display the round for which we will pay you and provide a breakdown of your total payment.

Once we complete the experiment, we ask that each of you complete a short survey. After completing the survey, we will provide instructions about where and how to receive your payment.

Also notice that we’ve provided you with paper and pen. You may use this to assist you with your calculations during each math game and/or use it to record Controller decisions, new agreement terms and payoffs for each period. This is not mandatory and is only provided as an aid.

What follows is a simplified version of today’s instructions. This is meant as an exercise to help ensure that each participant understands the structure of today’s experiment. Please raise your hand at any time if you have questions. It is important that you understand how this game is played so that you can earn as much money as possible.

Example payoff table:

Number	Payoff to A	Payoff to B
1	$4	$1
2	$5	$2
3	$3	$5

Example 1: If payoff number 2 is chosen, player A would receive a payoff of $5 and player B would receive a payoff of $2.

Example 2: Suppose player B is the Controller and chooses payoff number 3. Player A will have a chance to review this decision and then both players will proceed to the bargaining stage. Suppose player A cannot convince player B to change his decision. The game will end once the 180-second time limit expires. In this case, player B earns $5 for the period and player A earns $3 for the period.

Example 3: Suppose player A is the Controller and initially chooses payoff number 2. Player B will have a chance to review this decision and then both players will proceed to the bargaining stage. Suppose player B offers to transfer $2 to player A, conditional on player A agreeing to implement payoff number 3. Suppose player A agrees. Both players will click 'Deal' and then the Bargainer (here this is player B) will create a contract with the new terms. Player A accepts the terms. Now, player A earns $5 for this period and player B earns $3 for this period.

Are there any questions? If so, please raise your hand. Once the exercise starts, please do not speak to anyone except when using the chat box during the bargaining stage of each period. Remember, you will make two decisions with each of your partners. You will play this game with five partners.

Quiz
To check your understanding please answer the following questions using the payoff table **below** these questions. For each question, assume you are player A. When you are finished, please raise your hand and one of our staff members will go and check your answers at your station.

1. Number _____ makes me the most money. Number _____ makes me the least money.

2. If I become Controller, I can make $_____ even if the other person doesn't agree.

3. If I reach an agreement with B to choose number 4 and B agrees to pay me $2.00, I make $_____.

4. If I am the controller, I may choose the number that corresponds to my maximum payoff without making a joint agreement with the other person TRUE or FALSE? _____.

5. My partner and I have completed the first round. That means we have made _____ decision(s).

6. If I am the Bargainer, I can input a negative value into the contract screen (on page 4 of these instructions), which implies a transfer of money from the (Controller/Bargainer) to the (Controller/ Bargainer)? _____ to the _____.

[Same example Payoff Table as in face-to-face sessions]

B.3 Instructions: *Weak* Property Rights, 1-Shot

You are here today to participate in a simple economic study that will require you to make a series of 10 decisions total with 10 different partners (1 decision with each partner). Each of you is already situated at a computer station; you will remain at this computer station for the duration of the experiment. Our program will randomly match you with a new partner at the start of each period.

When we begin, we will assign each of you a letter that will serve as your identity for the duration of this experiment. We do this so that you can easily verify that you are matched with a new partner for each period of negotiations.

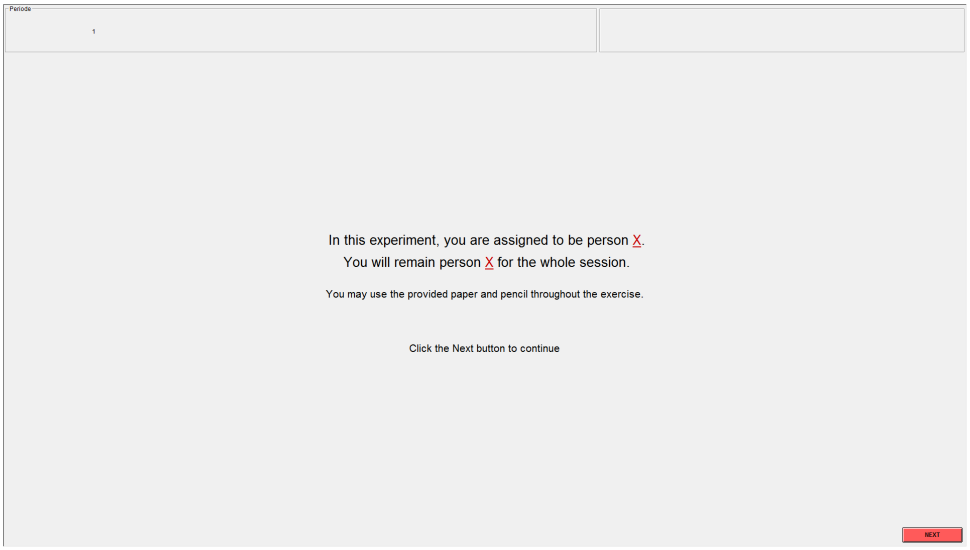

Figure 1. Example of the identity assignment screen

At the start of each period, we will randomly pair you with another player:

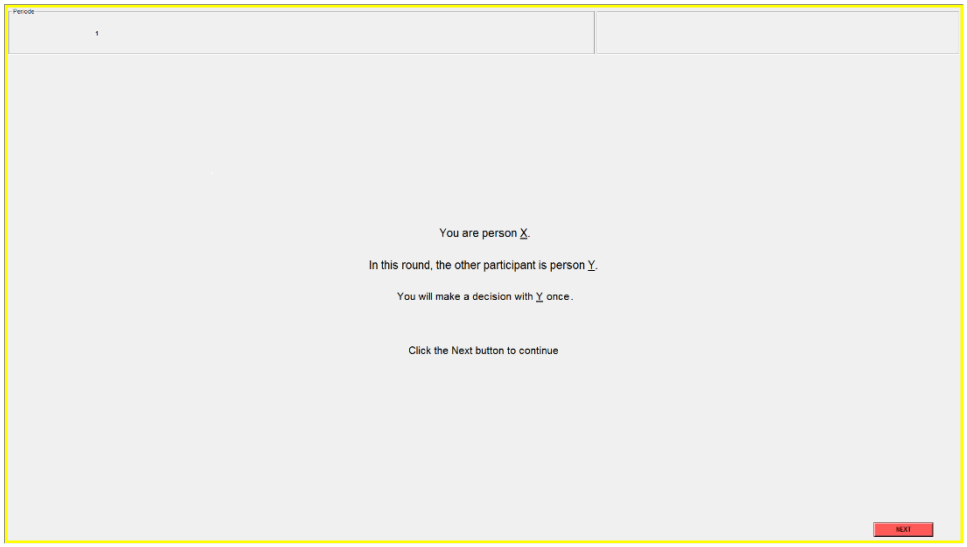

Figure 2. Example of the partner assignment screen

To begin the decision-making period with this player, the computer will **randomly designate** a role to each of you for that period. One of you will be designated as what we call the 'Controller', and will therefore have the right to dictate how much money both partners earn for that period.

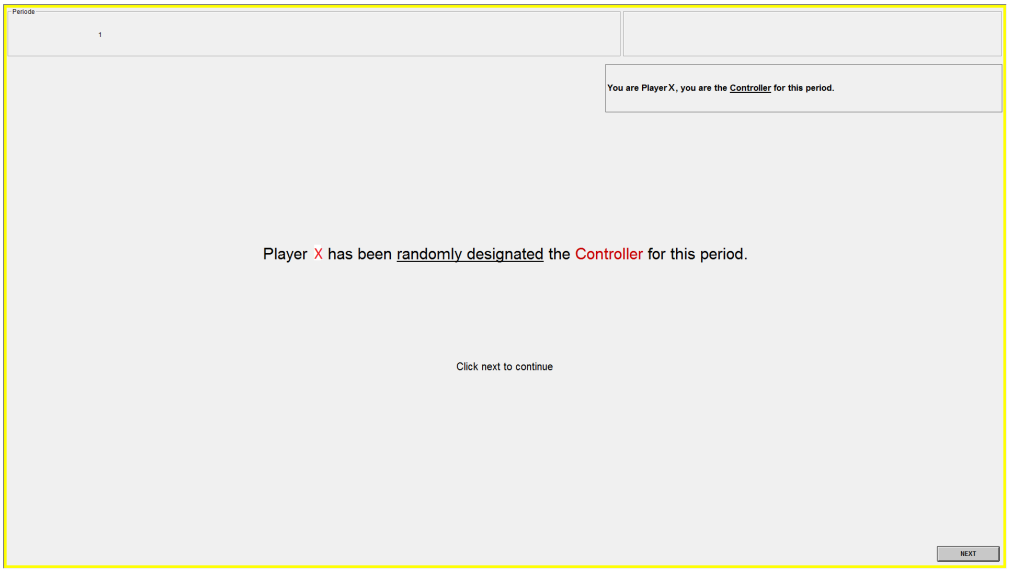

Figure 3. Example of the role designation screen

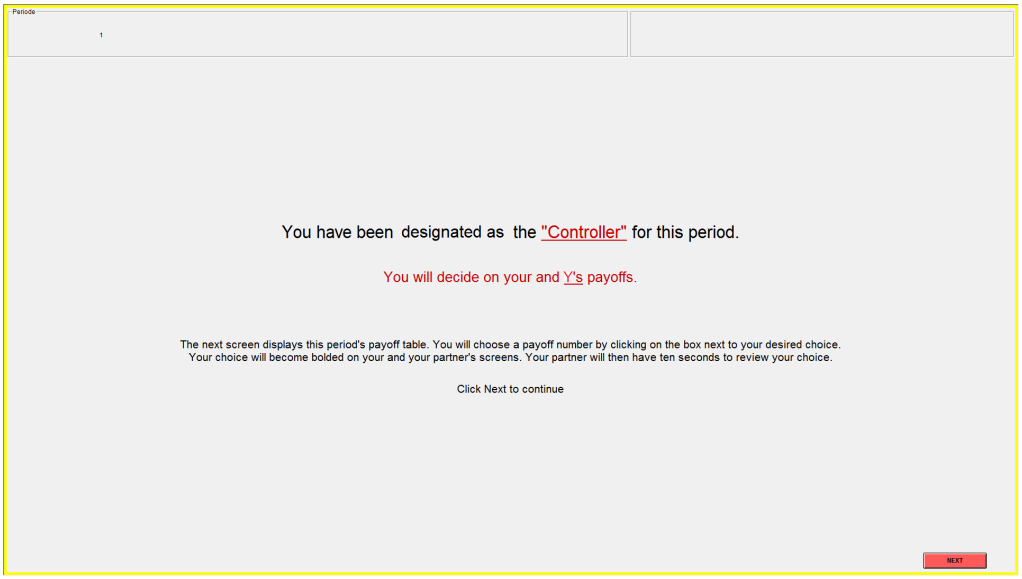

Figure 4. This shows you whether you are the Bargainer or the Controller.

Whoever is the Controller for a given decision period will choose a number from a payoff table (see Figure 5) that assigns payoffs to both players. This number is selected without agreement or input from the other player. After the Controller chooses a payoff, his/her partner, termed the 'Bargainer', will have a period of time to review the Controller's decision before both players progress to the bargaining stage.

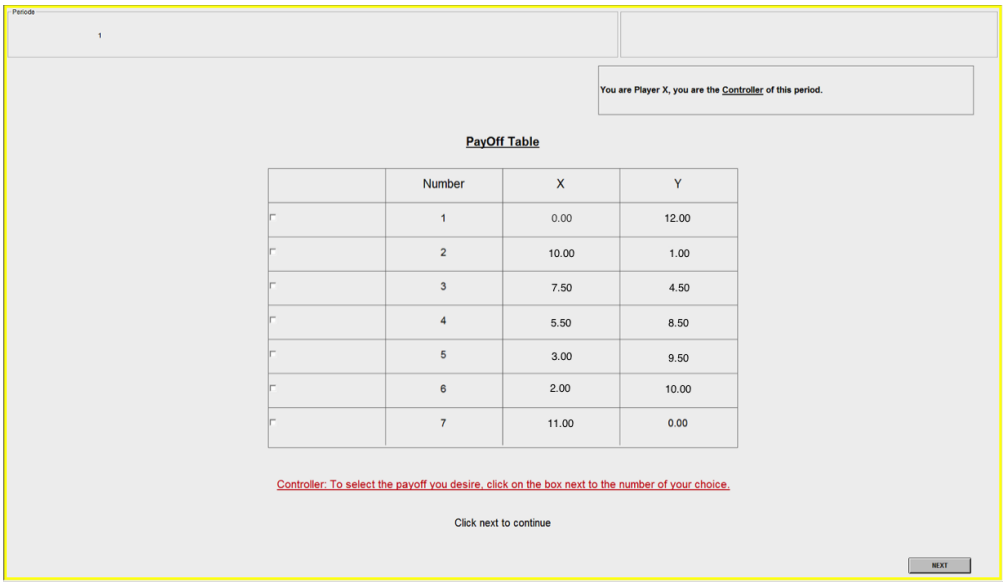

Figure 5. Example screen where Controller can select payoffs for both players. You will select a payoff by clicking on any one of the check boxes in the leftmost column.

During the bargaining stage, the Controller and Bargainer may attempt to jointly agree upon a new allocation by communicating via the provided chat box. Either the Bargainer or the Controller can offer/ agree to transfer all or some of their earnings (under payoffs from the new allocation) to the other player as part of this new agreement.

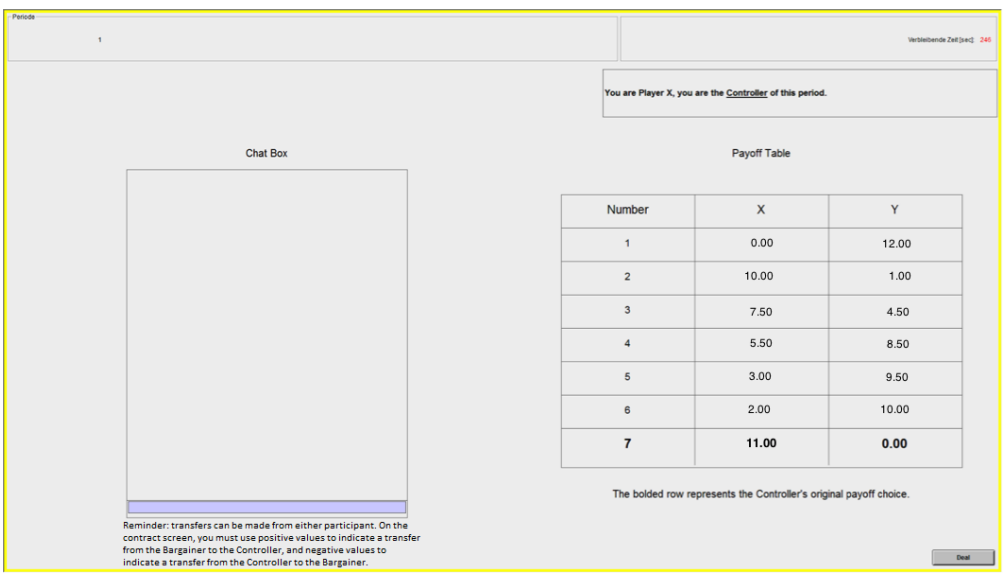

Figure 6. Example of the bargaining stage. Notice the 'Deal' button in the bottom right-hand corner.

The bargaining stage will last for a maximum of 180 seconds. If you and your partner negotiate a new deal, both players can click on the 'Deal' button in the bottom right corner of the screen to proceed. If either of the two players does not click the deal button, the period ends and both players receive payoffs corresponding to the Controller's original decision. For example: if the Controller is uninterested in negotiating a new deal, then he/she can wait for the 180 seconds to pass without clicking the 'Deal'

button, which will cause the period to end and both players will receive payoffs corresponding to the Controller's original decision.

If both players click the deal button, the period proceeds to the next stage, where the Bargainer will create a contract consisting of the **newly chosen payoff number** and **any agreed upon money transfer**.

Please note that negative values will represent a transfer of money from the Controller to the Bargainer.

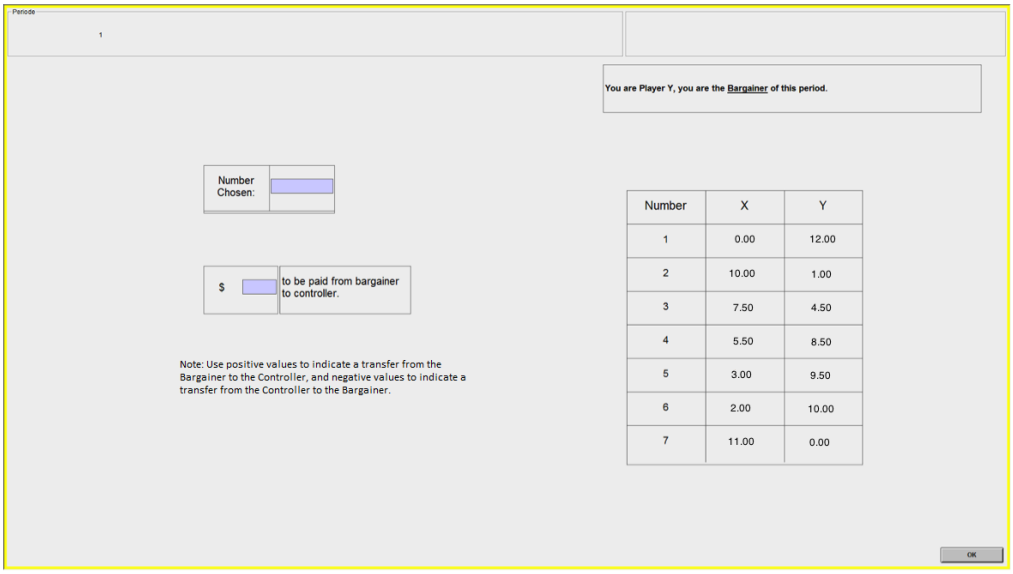

Figure 7. Example of the contract screen. Only the Bargainer will view this screen.

The Bargainer will submit this contract to the Controller by clicking 'Ok'.

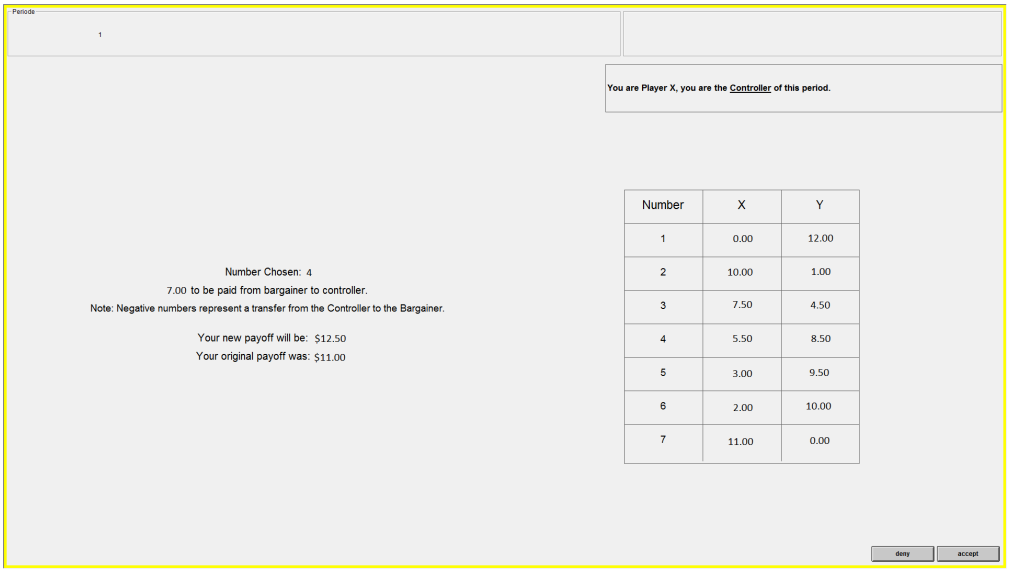

Figure 8. Example of the contract proposal that the Controller will see.

The Controller may either click 'Accept' to accept the contract or 'Deny' to deny the contract. Clicking 'Accept' will implement the new agreement and each player will receive payoffs corresponding to the

contract. Clicking ‘Deny’ will cancel the new contract and each player will receive payoffs corresponding to the allocation originally chosen by the Controller.

A period can thus end in any of the following ways:

- Either player does not click the ‘Deal’ button during the bargaining stage. In this case, payoffs from the Controller’s original choice prevail.
- Both players click ‘Deal’ during the bargaining stage and the Controller clicks ‘Deny’ to deny the contract offered by the Bargainer. In this case, payoffs from the Controller’s original choice prevail.
- Both players click ‘Deal’ during the bargaining stage and the Controller clicks ‘Accept’ to accept the contract offered by the Bargainer. In this case, payoffs corresponding to the contract will prevail.

Once you and your partner complete your decision for that period, you will remain at a waiting screen until all other pairs have finished making a decision. Once all pairs have completed the decision period, the next period will begin with a new partner.

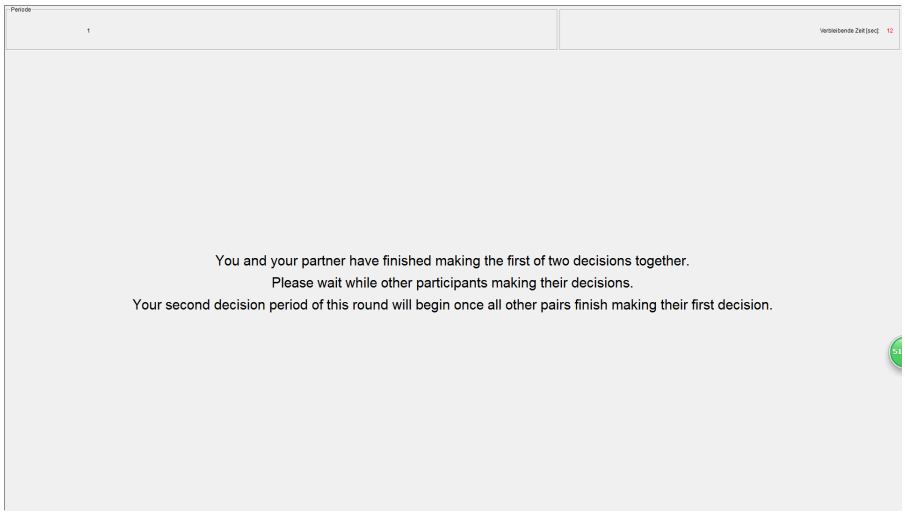

Figure 9. Example of the waiting screen.

Each period will proceed identically to the first. You will complete this process ten times (i.e., for 10 periods), each time with a new, randomly assigned partner.

Payment

Once you’ve completed all ten periods, our computer program will randomly choose two of the ten periods and we will pay you for the decision made in each of the two periods. Additionally, you will receive a $5.00 show-up fee. We will clearly display the periods for which we will pay you and provide a breakdown of your total payment.

Once we complete the experiment, we ask that each of you complete a short survey. After completing the survey, we will provide instructions about where and how to receive your payment.

Also notice that we've provided you with paper and pen. You may use this to assist you in recording things like Controller decisions, new agreement terms and payoffs for each period. This is not mandatory and is only provided as an aid.

What follows is a simplified version of today's instructions. This is meant as an exercise to help ensure that each participant understands the structure of today's experiment. Please raise your hand at any time if you have questions. It is important that you understand how this game is played so that you can earn as much money as possible.

Example payoff table:

Number	Payoff to A	Payoff to B
1	$4	$1
2	$5	$2
3	$3	$5

Example 1: If payoff number 2 is chosen, player A would receive a payoff of $5 and player B would receive a payoff of $2.

Example 2: Suppose player B is the Controller and chooses payoff number 3. Player A will have a chance to review this decision and then both players will proceed to the bargaining stage. Suppose player A cannot convince player B to change his decision. The game will end once the 180-second time limit expires. In this case, player B earns $5 for the period and player A earns $3 for the period.

Example 3: Suppose player A is the Controller and initially chooses payoff number 2. Player B will have a chance to review this decision and then both players will proceed to the bargaining stage. Suppose player B offers to transfer $2 to player A, conditional on player A agreeing to implement payoff number 3. Suppose player A agrees. Both players will click 'Deal' and then the Bargainer (here this is player B) will create a contract with the new terms. Player A accepts the terms. Now, player A earns $5 for this period and player B earns $3 for this period.

Are there any questions? If so, please raise your hand. Once the exercise starts, please do not speak to anyone except when using the chat box during the bargaining stage of each period. Remember, you will play this game with ten partners, and you will make one decision with each of them.

Quiz
To check your understanding please answer the following questions using the payoff table **below** these questions. For each question, assume you are player A. When you are finished, please raise your hand and one of our staff members will go and check your answers at your station.

1. Number _____ makes me the most money. Number _____ makes me the least money.

2. If I become Controller, I can make $_____ even if the other person doesn't agree.

3. If I reach an agreement with B to choose number 4 and B agrees to pay me $2.00, I make $_____.

4. If I am the controller, I may choose the number that corresponds to my maximum payoff without making a joint agreement with the other person TRUE or FALSE? _____.

5. My partner and I have completed the first period. In the next period, I will make another decision with my same partner from the first period TRUE or FALSE _____.

6. If I am the Bargainer, I can input a negative value into the contract screen (on page 4 of these instructions), which implies a transfer of money from the (Controller/Bargainer) to the (Controller/ Bargainer)? _____ to the _____.

[Same example Payoff Table as in face-to-face sessions]

B.4 Instructions: *Weak* Property Rights, 2-Shot

You are here today to participate in a simple economic study that will require you to make a series of 10 decisions total with 5 different partners (2 decisions with each partner). Each of you is already situated at a computer station; you will remain at this computer station for the duration of the experiment. Our program will randomly match you with a new partner at the start of each round, which will consist of two decision periods with that same partner.

When we begin, we will assign each of you a letter that will serve as your identity for the duration of this experiment. We do this so that you can easily verify that you are matched with a new partner for each round of negotiations.

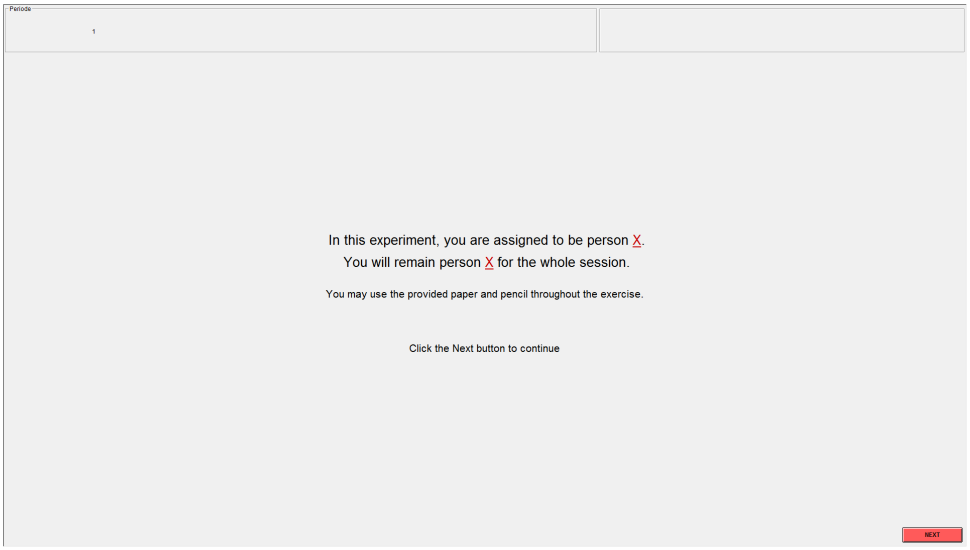

Figure 1. Example of the identity assignment screen

At the start of each round, we will randomly pair you with another player:

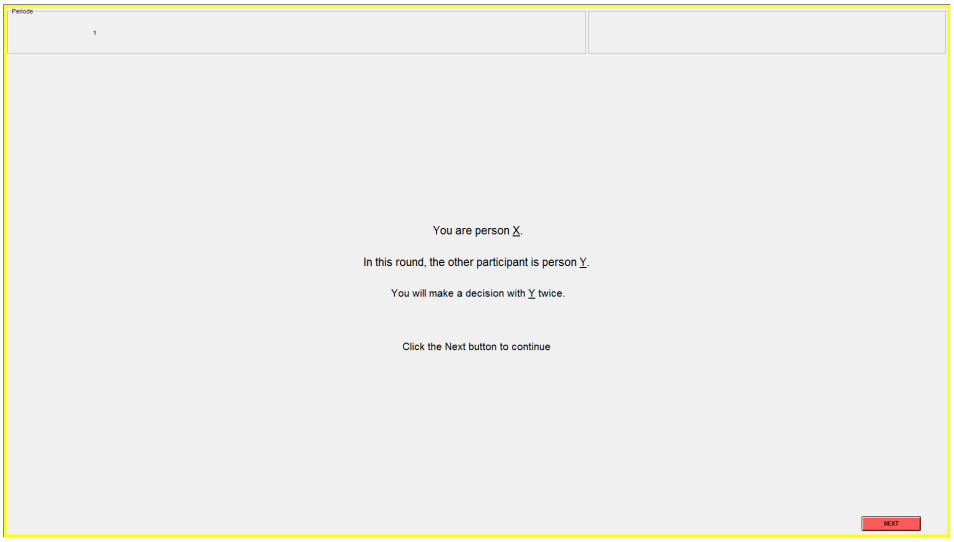

Figure 2. Example of the partner assignment screen

To begin your first decision making period with this player, the computer will **randomly designate** a role to each of you for that period. One of you will be designated as what we call the 'Controller', and will therefore have the right to dictate how much money both partners earn for that period.

Figure 3. Example of the role designation screen

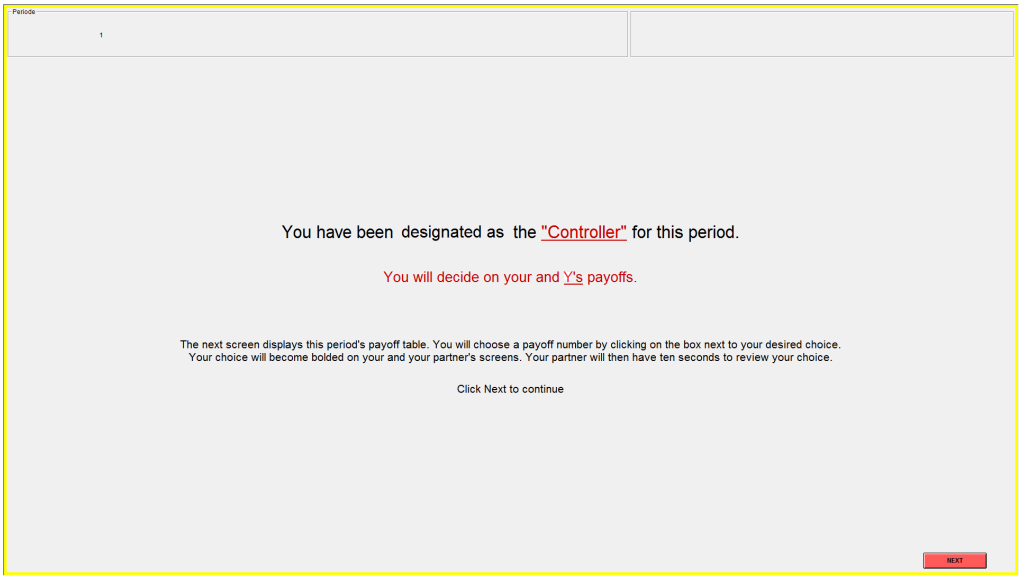

Figure 4. This shows you whether you are the Bargainer or the Controller.

Whoever is the Controller for a given decision period will choose a number from a payoff table (see Figure 5) that assigns payoffs to both players. This number is selected without agreement or input from the other player. After the Controller chooses a payoff, his/her partner, termed the 'Bargainer', will have a period of time to review the Controller's decision before both players progress to the bargaining stage.

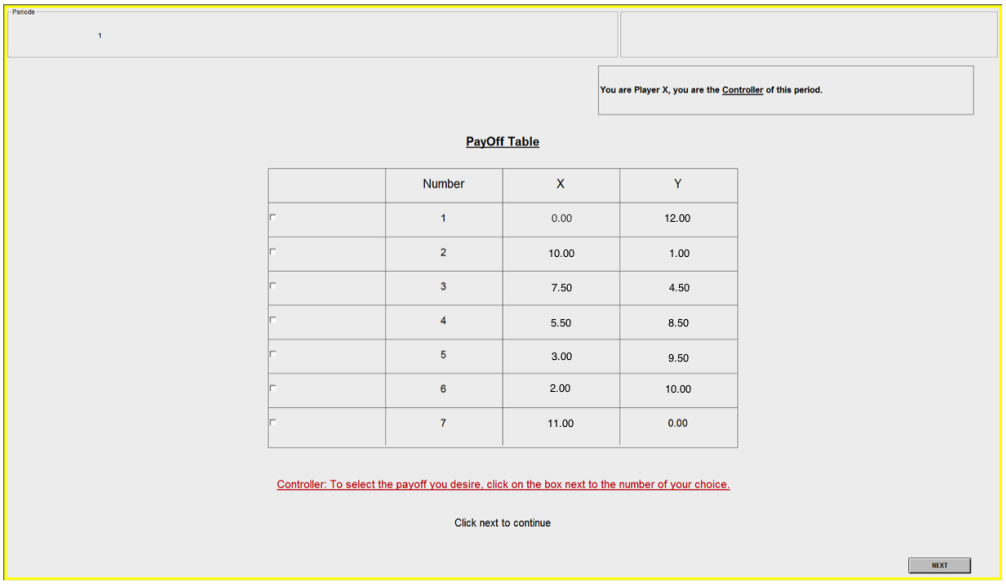

Figure 5. Example screen where Controller can select payoffs for both players. You will select a payoff by clicking on any one of the check boxes in the leftmost column.

During the bargaining stage, the Controller and Bargainer may attempt to jointly agree upon a new allocation by communicating via the provided chat box. Either the Bargainer or the Controller can offer/ agree to transfer all or some of their earnings (under payoffs from the new allocation) to the other player as part of this new agreement.

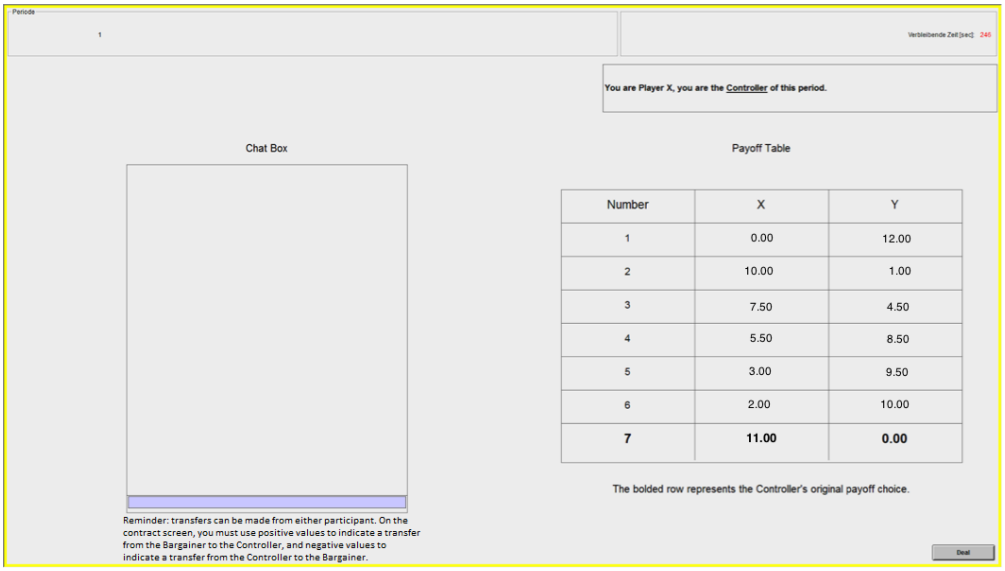

Figure 6. Example of the bargaining stage. Notice the 'Deal' button in the bottom right-hand corner.

The bargaining stage will last for a maximum of 180 seconds. If you and your partner negotiate a new deal, both players can click on the 'Deal' button in the bottom right corner of the screen to proceed. If either of the two players does not click the deal button, the period ends and both players receive payoffs corresponding to the Controller's original decision. For example: if the Controller is uninterested in negotiating a new deal, then he/she can wait for the 180 seconds to pass without clicking the 'Deal' button, which will cause the period to end and both players will receive payoffs corresponding to the Controller's original decision.

If both players click the deal button, the period proceeds to the next stage, where the Bargainer will create a contract consisting of the **newly chosen payoff number** and **any agreed upon money transfer**.

Please note that negative values will represent a transfer of money from the Controller to the Bargainer.

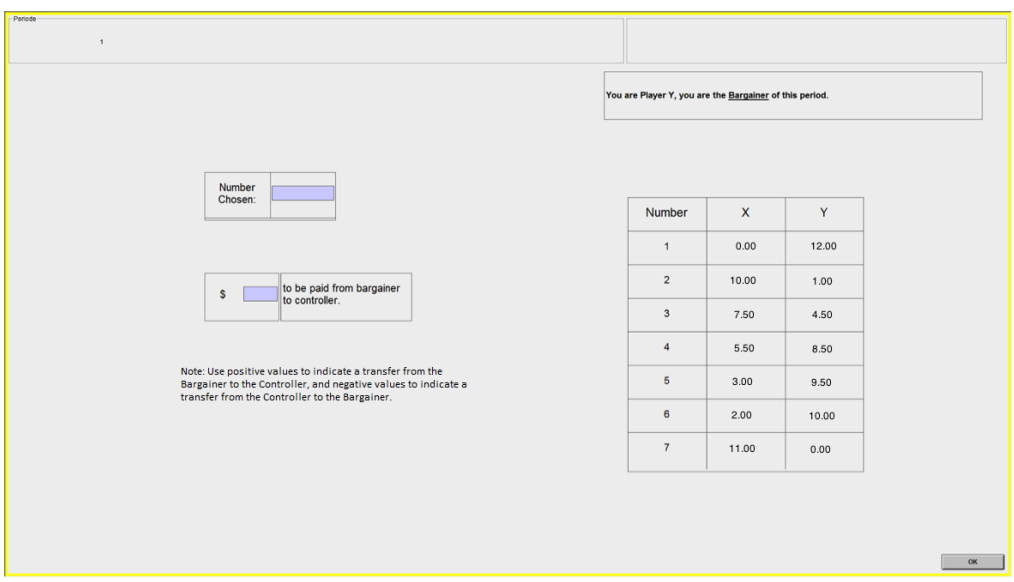

Figure 7. Example of the contract screen. Only the Bargainer will view this screen.

The Bargainer will submit this contract to the Controller by clicking 'Ok'.

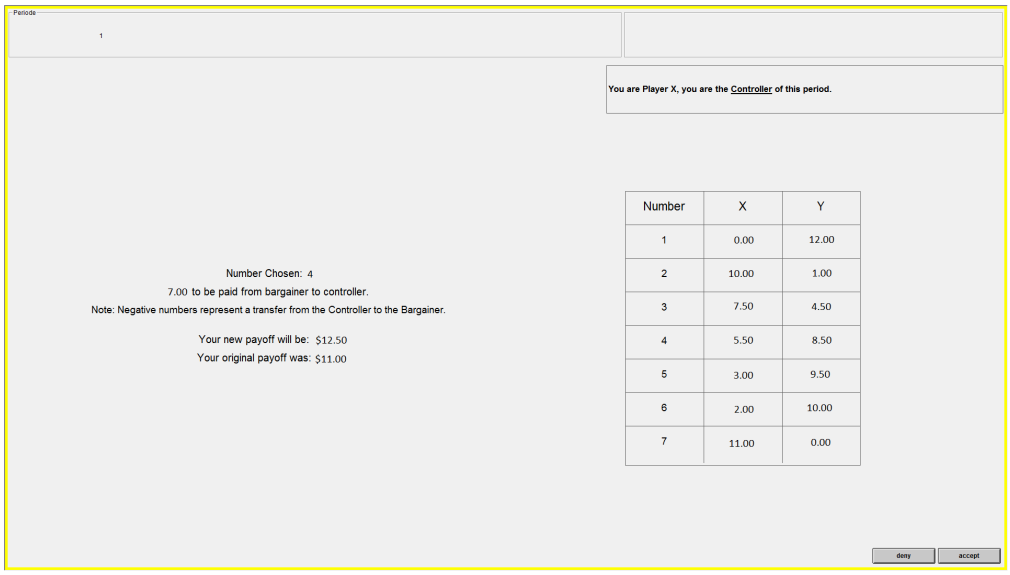

Figure 8. Example of the contract proposal that the Controller will see.

The Controller may either click 'Accept' to accept the contract or 'Deny' to deny the contract. Clicking 'Accept' will implement the new agreement and each player will receive payoffs corresponding to the contract. Clicking 'Deny' will cancel the new contract and each player will receive payoffs corresponding to the allocation originally chosen by the Controller.

A period can thus end in any of the following ways:

- Either player does not click the 'Deal' button during the bargaining stage. In this case, payoffs from the Controller's original choice prevail.
- Both players click 'Deal' during the bargaining stage and the Controller clicks 'Deny' to deny the contract offered by the Bargainer. In this case, payoffs from the Controller's original choice prevail.
- Both players click 'Deal' during the bargaining stage and the Controller clicks 'Accept' to accept the contract offered by the Bargainer. In this case, payoffs corresponding to the contract will prevail.

Once you and your partner complete your first of two decision periods, you will remain at a waiting screen until all other pairs have finished making a decision. Once all pairs have completed the first decision period, the second of the round's two decision periods will begin.

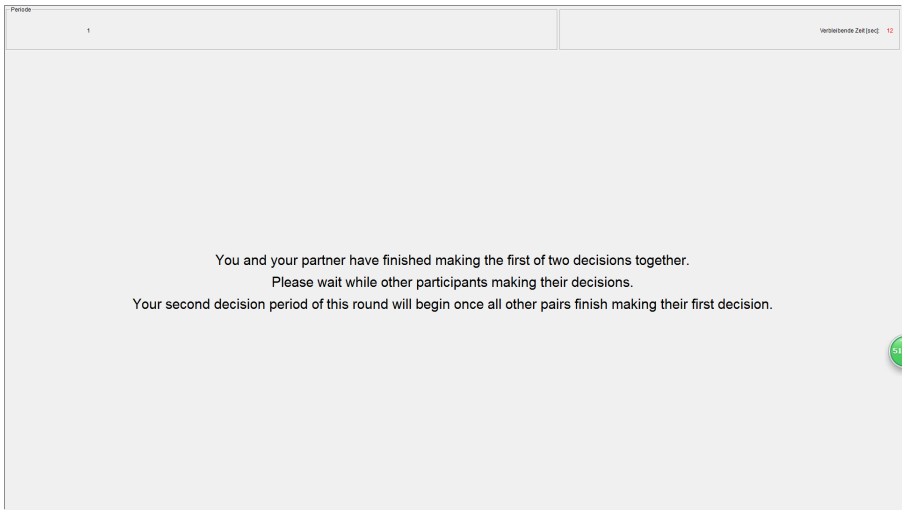

Figure 9. Example of the waiting screen.

This second period will proceed identically to the first. You will complete this two-period process five times (i.e. five rounds), each time with a new, randomly assigned partner.

Payment

Once you've completed all five rounds, our computer program will randomly choose one of the five rounds and we will pay you for both decisions made during that round. Additionally, you will receive a $5.00 show-up fee. We will clearly display the round for which we will pay you and provide a breakdown of your total payment.

Once we complete the experiment, we ask that each of you complete a short survey. After completing the survey, we will provide instructions about where and how to receive your payment.

Also notice that we've provided you with paper and pen. You may use this to assist you in recording things like Controller decisions, new agreement terms and payoffs for each period. This is not mandatory and is only provided as an aid.

What follows is a simplified version of today's instructions. This is meant as an exercise to help ensure that each participant understands the structure of today's experiment. Please raise your hand at any time if you have questions. It is important that you understand how this game is played so that you can earn as much money as possible.

Example payoff table:

Number	Payoff to A	Payoff to B
1	$4	$1
2	$5	$2
3	$3	$5

Example 1: If payoff number 2 is chosen, player A would receive a payoff of $5 and player B would receive a payoff of $2.

Example 2: Suppose player B is the Controller and chooses payoff number 3. Player A will have a chance to review this decision and then both players will proceed to the bargaining stage. Suppose player A cannot convince player B to change his decision. The game will end once the 180-second time limit expires. In this case, player B earns $5 for the period and player A earns $3 for the period.

Example 3: Suppose player A is the Controller and initially chooses payoff number 2. Player B will have a chance to review this decision and then both players will proceed to the bargaining stage. Suppose player B offers to transfer $2 to player A, conditional on player A agreeing to implement payoff number 3. Suppose player A agrees. Both players will click 'Deal' and then the Bargainer (here this is player B) will create a contract with the new terms. Player A accepts the terms. Now, player A earns $5 for this period and player B earns $3 for this period.

Are there any questions? If so, please raise your hand. Once the exercise starts, please do not speak to anyone except when using the chat box during the bargaining stage of each period. Remember, you will make two decisions with each of your partners. You will play this game with five partners.

Quiz
To check your understanding please answer the following questions using the payoff table **below** these questions. For each question, assume you are player A. When you are finished, please raise your hand and one of our staff members will go and check your answers at your station.

1. Number _____ makes me the most money. Number _____ makes me the least money.

2. If I become Controller, I can make $_____ even if the other person doesn't agree.

3. If I reach an agreement with B to choose number 4 and B agrees to pay me $2.00, I make $_____.

4. If I am the controller, I may choose the number that corresponds to my maximum payoff without making a joint agreement with the other person TRUE or FALSE? _____.

5. My partner and I have completed the first round. That means we have made _____ decision(s).

6. If I am the Bargainer, I can input a negative value into the contract screen (on page 4 of these instructions), which implies a transfer of money from the (Controller/Bargainer) to the (Controller/Bargainer)? _____ to the _____.

[Same example Payoff Table as in face-to-face sessions]

C. Payoff Table

Period 1

Number	Controller	Respondent
1	0.00	12.00
2	4.00	10.00
3	6.00	6.00
4	7.50	4.00
5	9.00	2.50
6	10.50	1.00
7	12.00	0.00

Period 2

Number	Controller	Respondent
1	0.00	12.50
2	1.50	11.00
3	3.00	9.50
4	4.50	8.00
5	6.00	6.50
6	10.00	5.00
7	11.50	1.50
8	13.00	0.00

Period 3

Number	Controller	Respondent
1	0.00	12.00
2	4.00	10.00
3	6.00	6.00
4	8.00	4.00
5	9.00	2.00
6	10.00	1.00
7	11.00	0.00

Period 4

Number	Controller	Respondent
1	0.00	11.00
2	1.00	10.00
3	2.00	8.00
4	4.00	6.00
5	5.50	5.00
6	9.00	4.00
7	10.50	1.00
8	9.00	0.00

Period 5

Number	Controller	Respondent
1	0.00	12.00
2	2.00	11.00
3	4.50	9.00
4	6.00	7.00
5	8.00	6.00
6	10.00	2.00
7	12.00	0.00

Period 6

Number	Controller	Respondent
1	0.00	12.50
2	2.00	10.50
3	4.00	9.00
4	5.50	7.00
5	6.50	6.50
6	11.00	4.00
7	12.00	1.00
8	13.00	0.00

Period 7

Number	Controller	Respondent
1	0.00	12.00
2	2.00	9.00
3	3.00	8.00
4	5.00	7.00
5	10.00	3.00
6	9.00	5.00
7	11.00	0.00

Period 8

Number	Controller	Respondent
1	0.00	11.00
2	1.50	10.50
3	3.00	10.00
4	5.00	6.00
5	5.50	5.50
6	10.00	2.00
7	8.00	3.00
8	9.00	0.00

Period 9

Number	Controller	Respondent
1	0.00	12.00
2	1.50	10.50
3	2.50	9.00
4	6.00	6.00
5	8.00	4.50
6	10.50	3.50
7	12.00	0.00

Period 10

Number	Controller	Respondent
1	0.00	12.50
2	1.00	10.00
3	3.00	9.00
4	4.00	11.00
5	7.00	5.00
6	10.00	2.00
7	8.00	3.00
8	13.00	0.00