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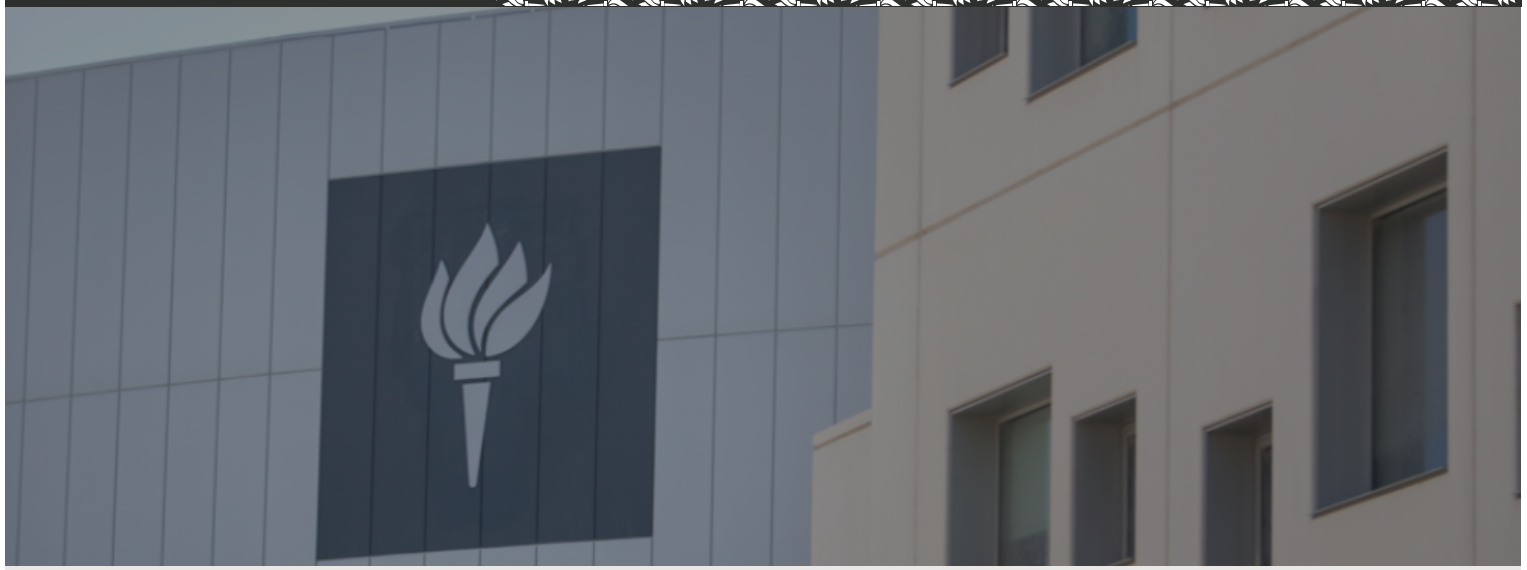

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The Timing of Communication and Retaliation in Bargaining: An Experimental Study*

Andrzej Baranski† Nicholas Haas‡

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Abstract

Communication is central to multilateral negotiations in settings such as legislatures, committees, juries, and corporate boards. We conduct an experiment to investigate how the timing of communication affects bargaining outcomes and dynamics in a multilateral, majoritarian bargaining game. We find that allowing for free-form written communication at the proposal-making stage results in behavior closer to equilibrium predictions. However, when communication channels are also open during the voting stage, the proportion of equilibrium play is between the proposal stage and no communication treatments. Communication in general affects bargaining dynamics in that, following a disagreement, voters strongly retaliate against failed proposers by offering them a lower share in subsequent rounds. Our results underscore the importance of a detailed analysis of processes and dynamics to understand bargaining outcomes, because even if communication leads to outcomes closer to equilibrium, the strategies employed by subjects need not resemble equilibrium.

Keywords: multilateral bargaining, communication, bargaining dynamics; laboratory experiment

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1 Introduction

Does communication between parties to a negotiation affect outcomes? Does it matter which protocols and procedures – who can say what, when, and to whom – are in place? Do bargainers account for the previous behaviors of their colleagues when negotiating? While negotiations are commonplace in political, business, and legal domains, data on the process of offers and counteroffers, and the content of communication, remain widely unavailable, obscuring how the dynamics of negotiations evolve in order to yield a given outcome.[1] Obtaining direct evidence of the interrelationship between the structure of negotiations, communication channels, and the process through which agreements are reached can further our understanding of how to model bargaining settings, which assumptions about human behavior are suitable and justified, and how to design more effective organizations.

One area where studies using real-world data have advanced our understanding of the bargaining process is legislatures.[2] However, they remain limited in their ability to provide clear and causally-identified conclusions about the effects of different protocols and procedures, communication patterns, and histories of bargaining interactions, on bargaining outcomes.

Notably, much of the communication and previous interactions between legislators is unobserved, it is not possible to control bargaining protocols or procedures, and it is difficult to account for the range of alternative factors that might drive observed behavior, such as a politician's long-run career goals. Thus, while for example case study or text-as-data analysis of debate data might tell us something about how communication in a public domain affects bargaining outcomes, we can still say little about what communication looks like in a private domain, or how communication across the two domains might interact. Further, because many negotiations take place in informal settings in which there is not a strict protocol or specified *order of moves*, it is complicated to identify the stages of the bargaining process. This makes it challenging to evaluate many game theoretic models, which typically conceptualize bargaining settings as a sequence of moves in which

[1] See Backus et al. (2020) for a notable exception using eBay data.

[2] In recent years, scholars have sought to tackle a number of these policy-relevant and theoretically compelling questions using real-world data. We have seen studies of legislative bargaining transparency, such as whether it takes place behind open or closed doors (Stasavage, 2004; Naurin, 2007); bargaining at different stages and degrees of formality (Bressanelli et al., 2016; Broniecki, 2020); and the roles of deliberation and communication – and, buoyed by advancements in text-as-data methodology, specific communication *content* – in determining legislative outcomes (Baturo et al., 2017; Lo Bianco and Princen, 2019; Naurin, 2010; Proksch et al., 2019; Wratil and Hobolt, 2019).

an offer must be made first and then voting takes place.[3]

Experimental research can address many of these challenges of using real-world data but has primarily focused on bargaining outcomes (i.e. agreed distribution of benefits) as opposed to the bargaining process (strategies and dynamics within a negotiation). While studies recently have focused more on the bargaining process – in part, hoping to bridge the gap between theoretical predictions of bargaining models and observed outcomes – the questions posed at the start of this Introduction call for further research.[4]

We conduct an experiment to shed additional light into the roles of communication and history of play on bargaining outcomes. In our multilateral, majoritarian bargaining games, which follow the closed-door model of legislative bargaining introduced by Baron and Ferejohn (1989), subjects are grouped in committees of three consisting of one randomly selected proposer and two randomly selected voters. The proposer suggests a division of $30, on which the two voters cast their votes; the proposer is automatically counted as voting in favor of the proposal. If the proposal garners a majority of votes, it passes and is implemented; if a majority votes against the proposal, then bargaining repeats for subsequent rounds until approval is reached. In each new round, roles are again assigned at random. However, subjects can be identified across bargaining rounds by identification numbers, and we display a history of play for all subjects to see.

We randomly assign subjects to treatments where they either are not allowed to communicate at all, are only allowed to communicate at the proposal stage, or are allowed to communicate at both the proposal and voting stages. In communication treatments, we allow for free-form written communication between a proposer and each voter privately, between each voter privately, and publicly between all three members of a committee.

We report a number of novel findings concerning outcomes and process. First, regarding outcomes, we observe that the *timing* of communication matters. Proposer power and adherence to equilibrium prediction are greatest where communication is allowed at the proposal stage only.

[3]While our preceding motivating example has focused on bargaining in legislatures, the same drawbacks for the empirical analysis of negotiations arise in other areas of study. For example, many business partnerships hold yearly profit-sharing meetings on which data is unavailable due to their private nature. Similarly, legal settlements often occur in private and communications are highly confidential, precluding researchers from studying the role of communication and the bargaining process.

[4]Recent studies that investigate bargaining processes include Gächter and Riedl (2006); Agranov and Tergiman (2014); Bolton and Karagözoğlu (2016); Baron et al. (2017); Agranov et al. (2020a); Chessa et al. (2021); Karagözoğlu and Kocher (2019); Bochet et al. (2020). See Literature Review section for greater discussion.

When communication is also allowed at the voting stage, proposer power falls and so do the proportion of outcomes resembling equilibrium. Moreover, subjects reach agreements fastest where communication is allowed at both the proposal and voting stages.

Second, concerning the bargaining process, we find that subjects engage in retaliatory behavior, punishing failed proposers from previous bargaining rounds deemed to have offered too little of the fund to other committee members. Retaliatory behavior is stronger in both games with communication compared to the no communication treatment. Importantly, this result runs contrary to the stationary subgame perfect equilibrium assumption, which is a popular equilibrium refinement in the multi-stage bargaining game-theoretic literature. Stationarity implies that bargaining behavior is not path dependent. Thus, even if communication leads to more equilibrium outcomes, subjects need not reach those outcomes via the predicted processes.

Our study promises to make numerous contributions to the extant literature. From a research design perspective, we are to our knowledge the first to test whether the *timing* of communication matters for bargaining outcomes. We thus build on previous work that has evaluated the effects of communication at the proposal stage only (relative to no communication, see Agranov and Tergiman (2014); Baranski and Kagel (2015)), to additionally consider the effects of bargaining at both the proposal and voting stages. We also code communication content at a more granular level than existing studies. Analytically, we add to studies on communication by investigating the history of negotiation, and whether it interacts with communication.

The article is structured as follows. In Section 2, we discuss the previous literature on the role of communication in experiments across different domains, as well as the study of bargaining process. In Section 3, we lay out our experimental design, followed by our theoretical predictions and experimental hypotheses in Section 4. Section 5 contains our analysis of bargaining outcomes and the path to agreements. In Section 6 we investigate the content of communication. Section 7 discusses and concludes the paper.

2 Previous Literature

The Baron and Ferejohn (1989) model of multilateral bargaining has been subject to many experimental investigations over the past two decades (see Baranski and Morton (in press) for a

meta-analysis and Agranov (2020) for a review). One robust finding is that minimum winning coalitions, that is, allocations of the surplus which exclude redundant members, are modal but not universal. Proposers extract larger rents, but nowhere close to equilibrium predictions.

Allowing subjects to communicate via chat screens during the proposal stage increases their share of the pie and brings it closer to equilibrium, a finding which Agranov and Tergiman (2014) and Baranski and Kagel (2015) report in groups of 5 and 3, respectively. Both studies find that competition between voters for a spot in the winning coalition creates competitive pressures which drive their asking shares down. Voters actively reach out to the proposer asking for the exclusion of others and these forces lead to enhanced proposer power. Importantly, when communication takes place in a setting in which the fund to distribute has been jointly produced by the group members, proposers and voters display less competitive behavior and more calls for fair sharing (see Gantner et al. (2019) and Baranski and Cox (in press)).

Our study focuses on varying *when* subjects can communicate and on the impact of communication on the bargaining process. To our knowledge, no other study seeks to identify the effects of the timing of communication, how bargaining evolves once agreements fail, and whether communication interacts with the history of negotiations. Furthermore, we also contribute to replication efforts in the experimental social sciences by conducting a communication treatment similar to that of Agranov and Tergiman (2014) and Baranski and Kagel (2015), which are the only two majoritarian Baron and Ferejohn experiments to date.[5] Our results underscore the relevance of replication because we find a milder effect of communication on proposer power relative to the effects reported in Agranov and Tergiman (2014) and Baranski and Kagel (2015).

Other researchers have investigated how the network structure of communication affects bargaining. Bolton et al. (2003) study a 3-player majoritarian free-form bargaining game in which the value of a coalition varies depending on its members, with some coalitions yielding a higher surplus to divide. By varying who can communicate with whom, Bolton et al. find that those who are central to the communication process are more likely part of a minimum winning coalition and enjoy a slight payoff advantage. In a related setting, scholars find that communication may also aid in fostering efficient coalitions (Bolton and Brosig-Koch, 2012). Baron et al. (2017) experimentally

[5]For communication in unanimity bargaining see Agranov and Tergiman (2019); for communication in a dynamic Baron and Ferejohn game see Baron et al. (2017); for communication under a stochastically varying pie see Agranov et al. (2020b).

vary the communication network in a dynamic legislative bargaining game and find that allowing only for public communication increases the equality of allocations compared to allowing only for private channels.

Our study contributes to the large and growing experimental literature exploring the role of communication in strategic domains for which Brandts et al. (2019) and Martinelli and Palfrey (2020) provide comprehensive reviews. Pre-play communication has been shown to foster efficiency in social dilemmas (Sally, 1995). In particular, Bochet et al. (2006) find that both face-to-face and written communication greatly increase contributions in a linear public goods game. However, the effect is mitigated when subjects differ in the benefits they receive from the public good (Gangadharan et al., 2017). Importantly, Koch et al. (2021) report that the timing of communication affects efficiency in a public goods game with punishment. (Koch et al., 2021, p.309) also write that "prior experiences of sanctioning and feuding are associated with a reduced likelihood of groups establishing covenants later on. Communication is therefore relatively ineffective in fully overcoming a history of sanctioning." The latter study is relevant to ours because we investigate whether the timing of communication impacts how likely a group is to delay agreements and the extent to which punishment towards failed proposers (in the form of exclusion from the coalition) is facilitated by communication.

In dilemmas with multiple equilibria, communication typically leads to enhanced efficiency particularly because it reduces strategic uncertainty and fosters coordination (Charness, 2000; Duffy and Feltovich, 2002). Cason et al. (2012) offer a caveat by showing that communication does not always lead to enhanced efficiency. In contests between groups, within-group communication can lead to an increase in rent-seeking investments, which entail lower efficiency compared to between-group communication. In the latter case, communication serves to temper competitive attitudes. Communication has also been employed in team decision-making experiments as a tool to investigate the motives and reasoning behind teams' actions (Arad et al., 2021; Bradfield and Kagel, 2015; Cooper and Kagel, 2005; Cox and Stoddard, 2018).

Finally, our work is related to the growing literature on the study of bargaining process. By process, we mean the sequence of moves (offers and counteroffers) that lead to an outcome. Ochs and Roth (1989) experimentally investigate two-player sequential bargaining games and show that, upon disagreement, subjects often make counteroffers that result in lower payoffs than what they would

have received should they have accepted the preceding offer. In unstructured bilateral bargaining with induced entitlements, Gächter and Riedl (2005, p.257) provide a measure of concessions, and find that "the greater the tension with respect to fairness judgments in a bargaining pair, the later concessions are made and the smaller the concessions are." Bolton and Karagözoğlu (2016) explore how varying the commitment power of subjects in a series of bilateral bargaining games affects the process of negotiations. They find that those holding less power to commit are more likely to make concessions. In a recent study, Bochet et al. (2020) provide an exploratory investigation of the negotiation process in a multi-issue setting. They find that endogenous bargaining dynamics in the form of alternating offers are correlated with higher agreement rates.

3 Experimental Design

In our control treatment without communication (No-Chat, hereafter), subjects are randomly assigned to groups of three which are endowed with a total fund of \$30. One subject is selected to propose a division of the fund which consists of a triplet of shares that must sum to \$30. Next, the other two subjects proceed to vote up or down simultaneously; the proposer is automatically counted as voting in favor. If at least one voter accepts, the decision is binding and payoffs are realized. Otherwise the process repeats itself until approval. Player identifiers are stable within a group, thus in case of a rejection, players are indentifiable in the subsequent round. A history of play indicating the identity of the previous proposers and corresponding proposals is publicly displayed.

In our first communication treatment, we allow for free-form written communication at the proposal stage (*P-Chat*, hereafter). The proposer's identity is revealed first so that subjects know their roles. Subjects can exchange messages bilaterally through *private channels* or publicly for up to three minutes. The remainder of the game proceeds as in No-Chat with communication allowed in each possible subsequent round. In our second communication treatment, we allow for the same communication features also at the voting stage (*P&V-Chat*, hereafter).

Subjects played a total of 15 games (or periods) with random re-matching, two of which were randomly selected for payment on top of an \$8 show-up.[6] Sessions were conducted at the CESS

[6]Two of our *P&V-Chat* sessions suffered a computer breakdown which resulted in terminating sessions in games 10 and 11.

experimental laboratory at New York University from February to early March 2020. Table 1 contains the details of our sample.

Treatments that are almost identical to *No-Chat* and *P-Chat* have been conducted in previous studies, hence we collected fewer sessions compared to *P&V-Chat*; 3, 4, and 6 respectively. A total of 186 subjects participated in our study.

	Communication at the:			
Treatment	Proposal Stage	Voting Stage	# Sessions	# Subjects
No-Chat	No	No	3	45
P-Chat	Yes	No	4	60
P&V-Chat	Yes	Yes	6	81

Table 1: **Experimental Treatments, Sessions, and Participants**

4 Theoretical Benchmarks and Behavioral Hypotheses

Under perfectly selfish and risk neutral preferences it is well-established that any allocation of the fund is a Nash Equilibrium in the Baron and Ferejohn majoritarian game. Moreover, any allocation is a subgame perfect Nash (Herings et al., 2018). It has been typically assumed that players use stationary strategies meaning that they employ identical strategies in identical subgames. This implies that their proposal behavior in each round within a game is independent of the history of play, and that their voting strategies are a function of the current proposal only.

Under the symmetric stationary subgame perfect equilibrium (SSPE), a unique payoff distribution arises: the proposer keeps \$20 and offers \$10 to any voter at random.[7] Voters accept any share greater than or equal to \$10 and approval occurs without delay.

Theoretically, the possibility to communicate cannot affect equilibrium because only messages that are in line with the equilibrium predictions are credible. Moreover, this is a game of perfect information, so there is nothing to be revealed. For example, a voter threatening to reject a share above \$10 or a proposer vowing to offer less than \$10 would not affect equilibrium play.

However, experimental evidence reveals that proposer power is closer to the SSPE prediction under treatments akin to *P-Chat* compared to *No-Chat* (Agranov and Tergiman, 2014; Baranski

[7] The share offered to voters makes them indifferent between rejecting and accepting and is derived in equilibrium. It corresponds to the continuation value of the game. Details can be found in Eraslan (2002).

and Kagel, 2015). Both Agranov and Tergiman (2014) and Baranski and Kagel (2015) find that in the presence of communication, proposers actively seek to form a coalition with voters that request low shares and that voters actively encourage the proposer to exclude others from the allocation of the fund. This *competition* effect drives reservation shares down closer to the theoretical benchmark.

Will allowing communication not only at the proposal, but also the voting stage, dampen this observed *competition effect*? Baranski and Kagel (2015) report instances where voters attempt to block the proposer and agree on excluding her in a subsequent negotiation round; however, these deals rarely materialize – only 25% of them do. The purpose of our *P&V-Chat* treatment is to further allow voters to negotiate with each other once the proposal has been made and thus to allow for further verbal commitments. If proposers anticipate that voters can attempt to collude, this may act as a deterrent for them to keep large shares. In this vein, we state our first behavioral hypothesis as follows:

Hypothesis 1. *The proposer's share is lowest in No-Chat, highest in P-Chat, and intermediate in P&V-Chat. Overall adherence to the SSPE predictions follows the same pattern.*

Our second behavioral hypothesis concerns voting behavior. Previous studies, with and without communication, have documented that the share of the pie a subject receives is the primary determinant of her voting decision (the correlation is positive). There is also evidence that the proposer's share has a negative effect. We conjecture that communication will increase the odds of voting in favor (controlling for the share offered and proposer's share) in *P-Chat* relative to *No-Chat*, and that *P&V-Chat* will fall in between. This is because once a proposal is made, voters may affect their partners' willingness to accept a proposal in *P&V-Chat* by persuading them to reject and collude against the proposer in a subsequent round.

Hypothesis 2. *Controlling for the offered share and proposer's demanded share, the probability of voting in favor is lowest in No-Chat, highest in P-Chat, and intermediate in P&V-Chat.*

We turn next to our final behavioral hypothesis, which concerns the bargaining process. The SSPE assumes that behavior in round t (or before) should not affect behavior in round $t+1$. In practical terms, one implication of this assumption is that the proposer in round $t+1$ will randomize over which voter to invite into their coalition regardless of their identity. As such, failed round t proposers should be offered, on average, an equal share as a previous voter.

The meta-analysis by Baranski and Morton (in press) showed that retaliation is present in treatments akin to *No-Chat*, with previous voters receiving a larger share than failed proposers. We conjecture that communication channels increase retaliatory behavior and that this will be higher in *P&V-Chat* compared to *P-Chat* due to the further deal-making possibilities for which communication at the voting stage allows.

Hypothesis 3. *Communication increases the likelihood of retaliation against failed proposers relative to No-Chat. Failed proposers will be offered lower shares under P&V-Chat than P-Chat.*

5 Experimental Results

We start by summarizing the main bargaining outcomes. Are the $30 split one-, two-, or three-ways? What is the proposer's mean share? How many rounds does it take groups to reach an agreement? Next, we turn to the determinants of voting behavior. Will the timing of communication affect subjects' willingness to vote in favor of proposals? Finally, we focus on the process of bargaining following a rejection.

Once we have dealt with our three main hypotheses, we turn to investigate general communication content patterns, if there are treatment differences in the content of communication, and how bargaining outcomes correlate with subjects' messages. To this end, in Section 6 we report results from a communication content analysis.

Throughout this Section, we will focus on approved proposals in all games unless stated otherwise.[8] In our regressions, each bargaining group is treated as an independent observation. We cluster standard errors at the subject and session levels.

5.1 Main Outcomes

In Table 2 we summarize the main outcomes. Two-way splits are the modal proposal format, representing above 70% of all agreements. We find no significant treatment differences in their prevalence.

[8]The aggregate evidence from Baron and Ferejohn (1989) experiments indicates a strong learning pattern in the initial games. When we restrict our sample to games 5 and beyond, and also for 10 and beyond, all our results hold robustly.

	Equilibrium Benchmark[1]	Is Communication Possible? Not Possible *(No-Chat)*	Proposal Only *(P-Chat)*	Proposal & Voting *(P&V-Chat)*
Type of Proposal:				
2-way Splits	100%	71.9	75.4	72.1
3-way Splits	0%	28.1	24.6	27.9
Proposer's Share:				
Overall	\$20	14.6	15.4	14.8
Within 2-way splits	\$20	15.8	16.7	16.4
Round of Approval:				
Round 1	100%	75.1	79.0	84.6
Round 2	0%	17.8	15.1	12.5
Equilibrium Play:				
SSPE[2]		9.5	35.8	20.9

[1] The equilibrium concept is the Stationary Subgame Perfect Equilibrium.
[2] An agreement is counted as SSPE play if the proposer's and included voter's shares are within \$2 of the strict definition.

Table 2: **Main Bargaining Outcomes**

Proposers keep on average \$15.4 when communication is possible only at the proposal stage, which is higher compared to the no communication treatment (\$14.6) although the difference is not significant at the 5% level or lower ($p = 0.064$, obtained from the OLS regression in Table 3). In the *P&V-Chat* treatment, the proposer keeps on average \$14.8. There are no statistically distinguishable differences in the proposer's share between *No-Chat* and *P&V-Chat* (p=0.683) and *P&V-Chat* and *P-Chat* (p=0.354) treatments.

The overwhelming majority of groups reach an agreement in the first round of bargaining. Consistent with previous findings, communication aids mildly in fostering round-one agreements. We find that the mean round of agreement is significantly lower in *P&V-Chat* compared to *No-Chat* (1.18 vs. 1.34, p=0.047) but there are no statistically distinguishable differences between *P-Chat* and *P&V-Chat* (1.28 vs. 1.18, p=0.324).

Does communication increase the likelihood of equilibrium play? Recall that the SSPE predicted agreement is a \$20-\$10 split between a proposer and voter regardless of whether communication is possible. In Table 2, we count as equilibrium play any two-way split in which the proposer and voter are within \$2 of the SSPE. Absent communication, we find that only 9.5% of agreements resemble

the SSPE. Under both communication treatments, SSPE agreements are more likely (35.8% in *P-Chat* and 20.9% in *P&V-Chat*). However, the difference is statistically significant only between *P-Chat* and *No-Chat* ($p = 0.003$). There are no statistically significant differences between *P&V-Chat* and *No-Chat* ($p = .130$) or *P&V-Chat* and *P-Chat* (p=0.125).

	Dependent Variable:			
	Two-way Split	Proposer's Share	Round of Approval	SSPE
P-Chat	0.035	0.803	-0.056	0.263**
	(0.079)	(0.395)	(0.079)	(0.070)
P&V-Chat	0.002	0.237	-0.155*	0.114
	(0.079)	(0.568)	(0.070)	(0.070)
Constant	0.719***	14.597***	1.340***	0.095**
	(0.056)	(0.270)	(0.010)	(0.030)
N	954	954	954	954
R^2	0.001	0.008	0.013	0.057

The No-Chat treatment is the base level.

Robust standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001

Table 3: **Linear Regression of Bargaining Outcomes**

Conclusion 1. *The proposer's share and overall adherence to the equilibrium outcomes is closest to the stationary subgame perfect equilibrium outcomes when communication is allowed only at the proposal stage, lowest when no communication is allowed, and intermediate when communication is allowed at the proposal and voting stages.*

Thus, we find evidence supporting hypothesis 1.

5.1.1 Voting Behavior

We now turn to investigate whether or not communication affects voting behavior (Hypothesis 2). Specifically, we test if the possibility to chat at the voting stage makes subjects less likely to vote in favor of a proposal, controlling for the offered share and the proposer's demanded share. Our linear regressions confirm a well-established result that the likelihood of voting in favor correlates positively with one's own share and negatively with the proposer's demanded share (see Table 4). Allowing for communication increases the likelihood of acceptance by 11.3 and 13.3 percentage points on average in *P-Chat* and *P&V-Chat*, with no statistically distinguishable difference between

the two (p=0.691, Wald test). Thus, we do not find that the timing of communication has an impact on voters' bargaining postures. In our analysis of communication content, we will further investigate the reasons behind this finding.

	(1) No-Chat	(2) P-Chat	(3) P&V-Chat	(4) Pooled
Own Share (in $)	0.055***	0.058***	0.058***	0.057***
	(0.000)	(0.004)	(0.003)	(0.002)
Proposer's Share (in $)	-0.017	-0.012*	-0.022*	-0.017***
	(0.007)	(0.003)	(0.006)	(0.003)
P-Chat				0.113**
				(0.036)
P&V-Chat				0.133**
				(0.036)
Constant	0.250	0.270*	0.435**	0.241***
	(0.108)	(0.055)	(0.099)	(0.055)
N	709	736	994	2439
R^2	0.526	0.530	0.579	0.553

The No-Chat treatment is the base level in column 4.

Robust standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001

Table 4: **Voting: Linear Regression**

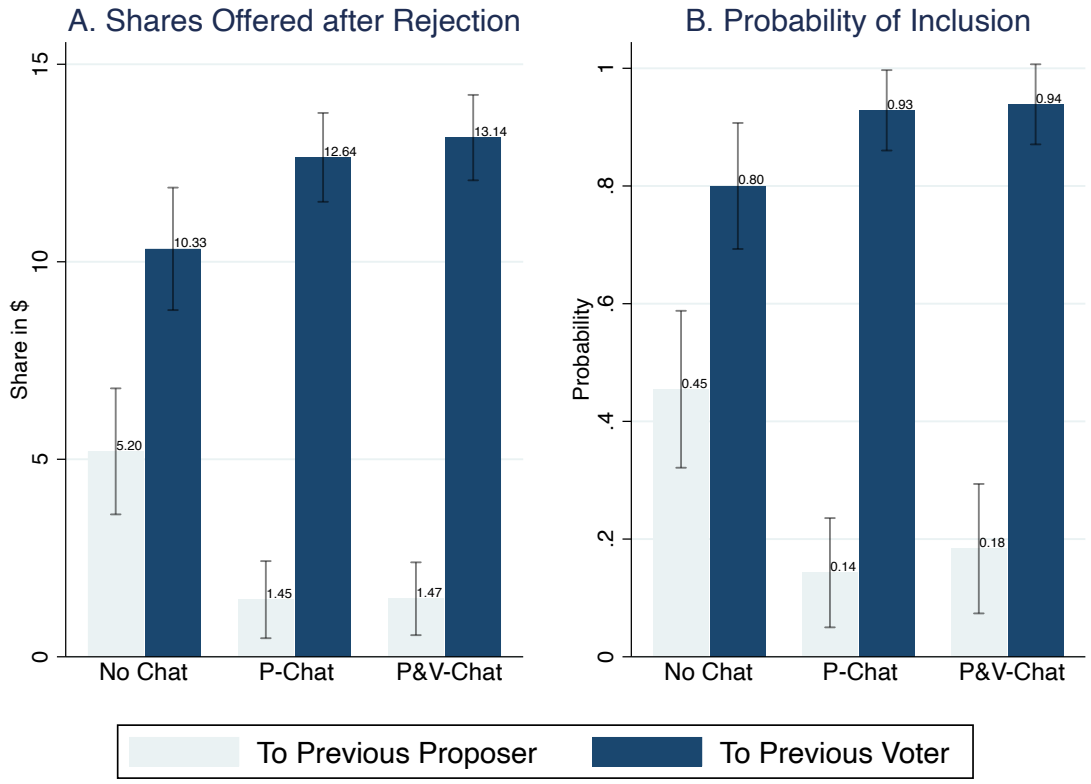
Conclusion 2. *Communication channels in P-Chat and P&V-Chat make subjects more likely to vote in favor, controlling for the offered share and the proposer's demanded share.*

Thus, we partially support Hypothesis 2 in that communication leads to enhanced willingness to vote in favor.

5.1.2 Round 2 and Beyond: History of Play and Retaliation

How do subjects bargain following a rejection? Are failed proposers punished? Does communication affect how subjects react to the history of play? Recall that the SSPE assumes history-independent behavior meaning that, upon a rejection, all players should be treated equally.

To investigate whether subjects abide by stationary strategies we investigate if there are differences between the shares that are offered to failed proposers and previous voters. As shown in Figure 1, the mean share offered in the current round t to the subject that proposed in round $t-1$



Notes: Panel A shows the mean share that is offered in round t to players disaggregated by their treatment assignment and their role in round $t-1$. Failed proposers receive lower shares than those who were voters in the preceding round. We only include proposals by subjects that did not propose in the preceding round and exclude the share that they are demanding for themselves. In Panel B we show the proportion of times a member receives a positive share (i.e. is included in the coalition). 95% confidence intervals are included.

Figure 1: **Shares Offered following Rejection, by Recipient Role in Previous Round**

is lower than the share offered to $t-1$ voters (those who did not propose). Notably, communication has a positive and significant effect on this gap: failed proposers receive approximately \$11 less than non-proposers (\$1.5 vs \$13) when communication channels are open, and \$5 less when they are closed. The treatment differences are significant at the 5% level (see regression results presented in Table 5). A similar pattern is observed when we focus on the likelihood of being included in the proposer's coalition, which evidences that retaliation is quite extreme and takes the form of total exclusion of failed proposers from the sharing of the pie (See panel B in Figure 1).

Conclusion 3. *Subject behavior following a disagreement is history-dependent (or non-stationary). Failed proposers have a lower expected continuation value and previous voters a higher one. The effect is stronger in treatments with communication.*

Thus, we find partial support for Hypothesis 3, in that communication increases the likelihood

	(1) No-Chat	(2) P-Chat	(3) P&V-Chat	(4) Pooled
To Previous Proposer (=1 if yes)	-5.127	-11.196**	-11.673**	-5.127*
	(2.717)	(1.287)	(1.511)	(2.325)
P-Chat				2.316
				(1.327)
P&V-Chat				2.816
				(1.433)
To Previous Proposer × P-Chat				-6.069*
				(2.602)
To Previous Proposer × P&V-Chat				-6.546*
				(2.722)
Constant	10.327*	12.643***	13.143***	10.327***
	(1.398)	(0.633)	(0.843)	(1.196)
N	110	112	98	320
R^2	0.160	0.665	0.731	0.528

The No-Chat treatment is the base level in column 4.

Robust standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001

Table 5: **Linear Regression of Share Offered in Rounds following a Previous Rejection**

of retaliation.

6 Communication Content and Bargaining Behavior

In this Section, we report results from a content analysis of communication between proposers and voters in our bargaining game. We first describe our coding and validation processes, before turning to a presentation of communication patterns, and finally an analysis of the relationship between communication, our treatments, and the bargaining outcomes reported in Section 5 above.

6.1 Coding and Validation

In order to evaluate communication content, we first needed to create a typology of different types of content that we could subsequently use to categorize messages based on a sampling of the sessions.[9] Table 6 displays our coding categories. We chose categories with three aims in mind. First, we wanted our categories to accurately reflect individuals' discussions. Second, we

[9]Our procedures are close to those employed by Cason et al. (2012) and Baranski and Kagel (2015), with the difference that we hired three coders.

sought to capture concepts of theoretical interest and which we expected might offer explanatory power. Third, we wanted to measure concepts, such as minimum winning coalitions, that we also investigated behaviorally so that we could compare subjects' communications on a specific topic with observed bargaining outcomes on that same topic.[10]

Category	**Coded as Having Occurred Whenever a:**	**Example(s)**
Equality (all-way split)	Member states all three members should receive non-zero share of fund.	"I will give everyone something"
Minimum Winning Coalition	Proposer says they will only give money to one voter. Voter tells the proposer that the other voter should receive \$0.	"Let's split us two in half" "Me 13, you keep the rest"
Competition	Proposer tells a voter how much the other voter is willing to accept. Proposer tells a voter that the other voter is willing to accept less. Proposer tells a voter that they are looking for the cheapest voter. Voter seeks to undercut or match amount demanded by other voter.	"I will take less than the other voter" "I will match the other person"
Desired Share	Member states how much they will accept.	"Give me 50%"
Future Coalition	Voters attempt to strike a deal of a future coalition.	"The proposer is giving us too little, let's reject and divide ourselves"
Punishment of previous round's proposer	Member says the previous round's proposer should receive a lower share. Member discusses retaliation or punishment toward the previous proposer.	"Player 1 only offered us \$2 last round, let's give them nothing"
Convince to reject (P&V, Voting Stage)	Member seeks to convince another member to vote against a proposal.	"No way you should accept an offer that small"
Convince to accept (P&V, Voting Stage)	Member seeks to convince another member to vote in favor of a proposal.	"You should vote in favor, you won't get better"
Irrelevant	All the messages are unrelated to the task.	Only greetings are exchanged.

Notes: *P&V* refers to the Proposal & Voting treatment. Convince to reject and convince to accept discussions were coded only for the voting stage; discussions of forming a future coalition were coded for both proposal and voting stages; and all other content categories were coded for the proposal stage only.

Table 6: Communication Categories

To increase the validity of our coding exercise, we hired three research assistants and had each code the entire corpus of conversations in the *P-Chat* and *P&V-Chat* treatments according to the categories in Table 6. Coders were provided with detailed instructions on the different coding categories and how to apply them to the data and were trained by one of the authors on this paper (see Appendix Section A). In addition to coding the content of a particular message, coders also identified from whom the message originated (the proposer or one of two voters), between which members it occurred (a proposer and a voter, between all three members, or between the two voters), and, for our *P&V-Chat* treatment and coalition content category, whether the message occurred at the proposal or voting stage. Overall, we observe a high degree of agreement among

[10] We originally had aimed to code for whether subjects discussed anticipation of the voting stage communication channels, but found no single session where this occurred. We also initially thought all categories should be coded in both channels (private and public) and in both stages (proposal and voting) but it became clear that this was redundant and unnecessary.

our three coders.[11] In our main analyses, we further only consider a message as belonging to a given category if at least two of three coders counted it as such.

6.2 Communication Patterns

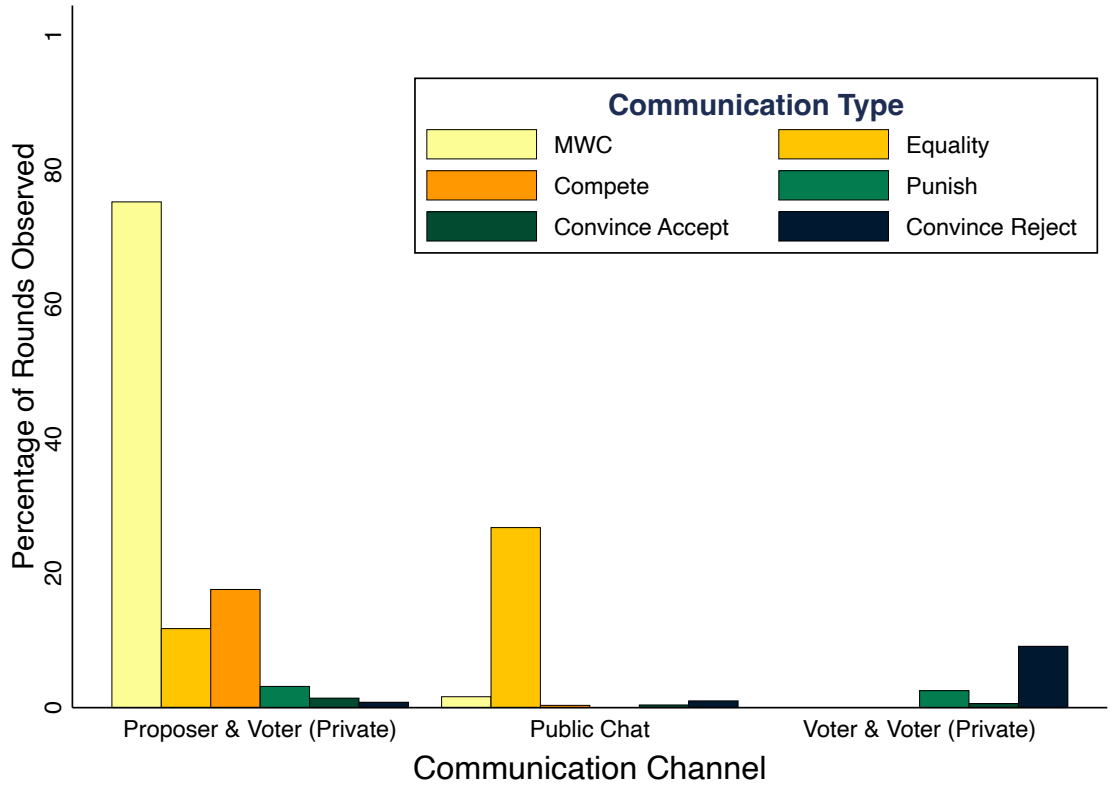
Figure 2 displays frequencies of the different categories of communication observed in each possible channel of communication: between a proposer and voter in private, between two voters in private, and between all members of the group. We present results for communication at the proposal stage only, and pool across our *P-Chat* and *P&V-Chat* treatments. MWC, competition, and equality categories were not coded for communication between voters, as our focus for these categories centered on communication between a proposer and voter (see Table 6).

MWCs were discussed between proposers and voters in private in approximately 75% of bargaining rounds, constituting by a large margin their most dominant topic of communication. In contrast, we observe that equality was most often discussed by members in the public chat (in 27% of cases). Overall, equality is discussed comparatively more, and MWCs and competition comparatively less (both under 2%), with public communication as opposed to private communication between proposers and voters. We are also more likely to observe efforts to convince a member to vote against a proposal in communication between voters (9% of the time), as compared with public communication or communication between proposers and voters (both approximately 1%). Appendix Table C1 shows that these differences are statistically distinguishable from zero when controlling for treatment assignment and clustering at the session and subject levels.

Turning to categories that were only coded for a single type of communication channel, we find that voters and proposers discussed desired shares 77% of the time, and that voters discussed forming future coalitions with other voters in 27% of cases. Approximately 1% of conversations were coded as irrelevant. Overall, we observe a higher frequency of communication fitting a coding category in communication between proposers and voters (79% of cases), as compared with communication between all members (28%) and communication between voters only (29%).

Were proposers more or less likely than voters to communicate certain topics? Did communication content differ in our *P-Chat* and *P&V-Chat* treatments? Figure 3 displays communication

[11] An inter-rater agreement test yields a kappa of 0.81, which falls in the range defined as "almost perfect" agreement according to the most commonly used criteria (Landis and Koch, 1977). Consistently, Pearson correlation coefficients between the three coders – respectively, 0.78, 0.81, and 0.84 (all $p < 0.01$) – indicate a strong positive relationship.



Notes: This figure displays the percentage of rounds in which at least one discussion between proposers and voters, voters and voters, or all members, was coded by a majority of coders as containing each type of communication category (see Table 6). MWC, equality, and compete categories were not coded for the voter and voter communication channel. Coalitions and desired share were only coded for, respectively, communication between voters and between voters and proposers, and are not included in this comparative figure. We pool across *P-Chat* and *P&V-Chat* treatments and thus only consider content at the proposal stage (with the exception of convince to accept and convince to reject categories, which were only coded at the voting stage and thus for the *P&V-Chat* treatment only).

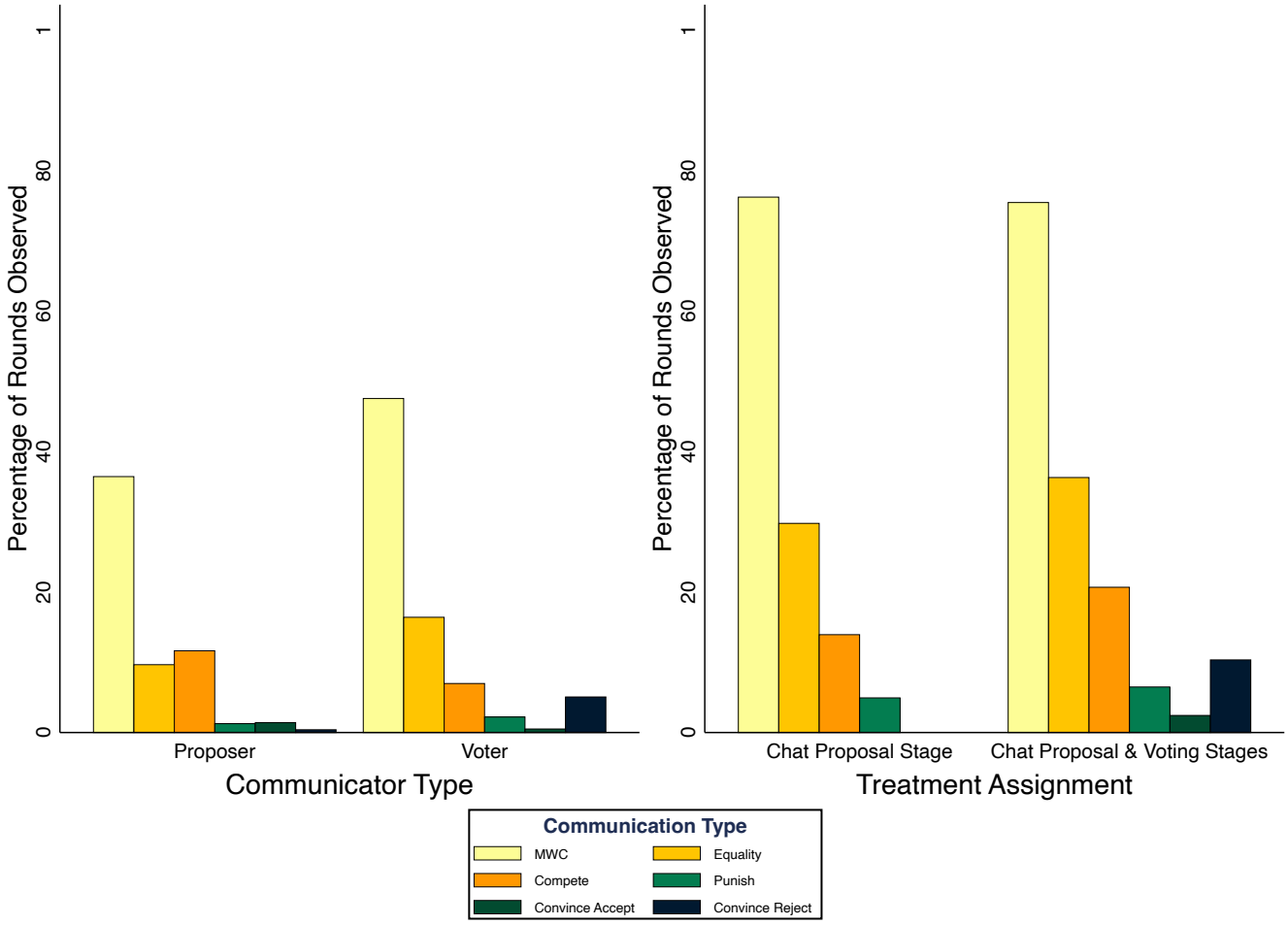
Figure 2: **Frequency of Communication Type by Channel**

patterns, split by the type of player sending a message (proposer or voter, left panel) and treatment assignment (*P-Chat* or *P&V-Chat*, right panel). Beginning with communicator type, we observe that voters are more likely than proposers to send messages regarding MWCs, equality, and to attempt to convince another member to vote against a proposal (all statistically distinguishable from zero, see Appendix Table C1).

We do not observe any statistically distinguishable differences across *P-Chat* and *P&V Chat* treatments in the proportions of members discussing at the proposal stage MWCs, equality, competition, or punishment, or their desired shares or the possibility of future coalitions.[12,13] Nor do

[12]Recall that convince to accept and convince to reject categories were only coded at the voting stage and thus we cannot compare frequencies for these categories across treatments.

[13]We also do not observe any difference in the proportion of voters proposing coalitions when including voting stage communication in the *P&V-Chat* treatment, which occurred in approximately 12% of bargaining rounds.

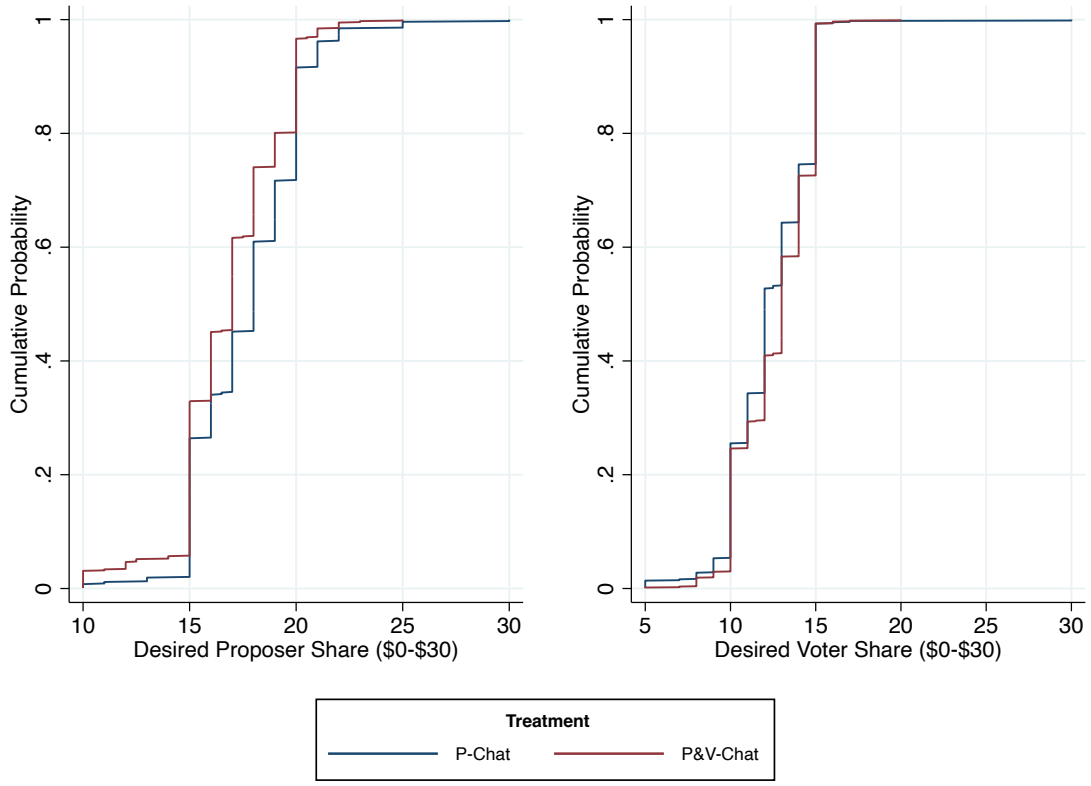


Notes: The left panel of this figure displays the percentage of rounds in which a given proposer or voter shared a message coded by a majority of coders as containing each type of communication category (see Table 6). The right panel compares communication type percentages across our two treatments with communication: *P-Chat* and *P&V-Chat*. All content categories displayed for both treatments were only coded for the proposal stage; convince accept and convince reject, which are only displayed for the *P&V-Chat* treatment, were only coded for communication at the voting stage and thus can only be shown for this treatment.

Figure 3: **Frequency of Communication Type by Sender, Treatment**

we observe any evidence of an interaction effect between communicator type and treatment assignment, and the frequency of different communication categories (see Appendix Table C1). However, while we do not observe treatment differences in the *proportions* of voters or proposers discussing desired shares, we do observe differences in the *amounts* that proposers tend tend to request from their committee members. Specifically, proposers tend to state higher desired shares *P-Chat* treatment as compared with the *P&V-Chat* treatment (see Figure 4), results that are consistent with bargaining outcomes (see Table 2) and Hypothesis 1.

The results detailed above provide some insights into communication patterns in our bargaining game. First, it appears that many subjects used communication strategically; we observe, for



Notes: This figure compares proposers' (left panel) and voters' (right panel) stated desired shares across treatments with communication (*P-Chat* and *P&V-Chat*). Kolmogorov-Smirnov tests indicate that the distribution functions are not equal for both proposers (left panel, $p < 0.001$) and voters (right panel, $p < 0.001$).

Figure 4: **Proposer and Voter Desired Shares by Communication Treatment**

instance, that they choose to communicate different content depending on their audience (Figure 2). Second, we find that a substantial portion of strategic communication occurred between proposers and voters in private. Third, we observe some evidence that communication patterns differed depending on a player's role; in particular, voters were more likely than proposers to attempt to convince other members to vote against a proposal and to initiate conversations about equality, and were less likely to suggest MWCs or to engage in competition. Next, we turn to an analysis of communication, our treatment assignments, and observed bargaining behavior.

6.3 Communication Content, Stages of Communication, and Bargaining

To what degree does communication content match observed bargaining behavior? To investigate this question, we can test whether, for instance, proposals are more likely to be equal where a member of the bargaining group stated that all members should receive a non-zero share of the

fund. Figure 5 presents results, clustering at the session and subject levels and controlling for treatment assignment.[14] We find a strong relationship between communication content and observed bargaining outcomes: notably, MWCs are more likely to be observed when group members discuss MWCs, as are equal divisions of the fund when group members discuss equality; proposals are less likely to be accepted where voters discuss forming a future coalition; and equilibrium outcomes are more likely to be observed where proposers engage voters in competition.[15,16] Effects are often stronger where proposers initiate communication topics, perhaps reflecting expected superior proposer power.

Do communication patterns support the notion that subjects engage in history-dependent behavior (see Section 5.1.2)? To evaluate this question, in Figure 6 we consider whether there are differences in the shares offered to a previous round's proposer and voters (as in Figure 1), based additionally on whether voters in that previous round discussed forming a future coalition or not.[17] Consistent with retaliation, we not only find that failed proposers are punished in subsequent rounds, but especially where voters had discussed in previous rounds forming a coalition.[18]

Does the relationship between communication content and observed bargaining outcomes differ depending on whether subjects were permitted to communicate at the proposal only versus the proposal and voting stages? We find that where voters discuss future coalitions at the voting stage, proposals are less likely to be accepted, mirroring findings as regards coalition discussion at the proposal stage (see Appendix Table C8 and Figure 5). However, we do not find any evidence that the strength of the relationship between coalition discussion at the proposal stage, as compared with the voting stage, and proposal acceptance, differs. Nor do we observe that the occurrence of certain communication content categories has a different impact on bargaining outcomes depending on treatment assignment. Thus, the relationship between MWC discussion at the proposal stage

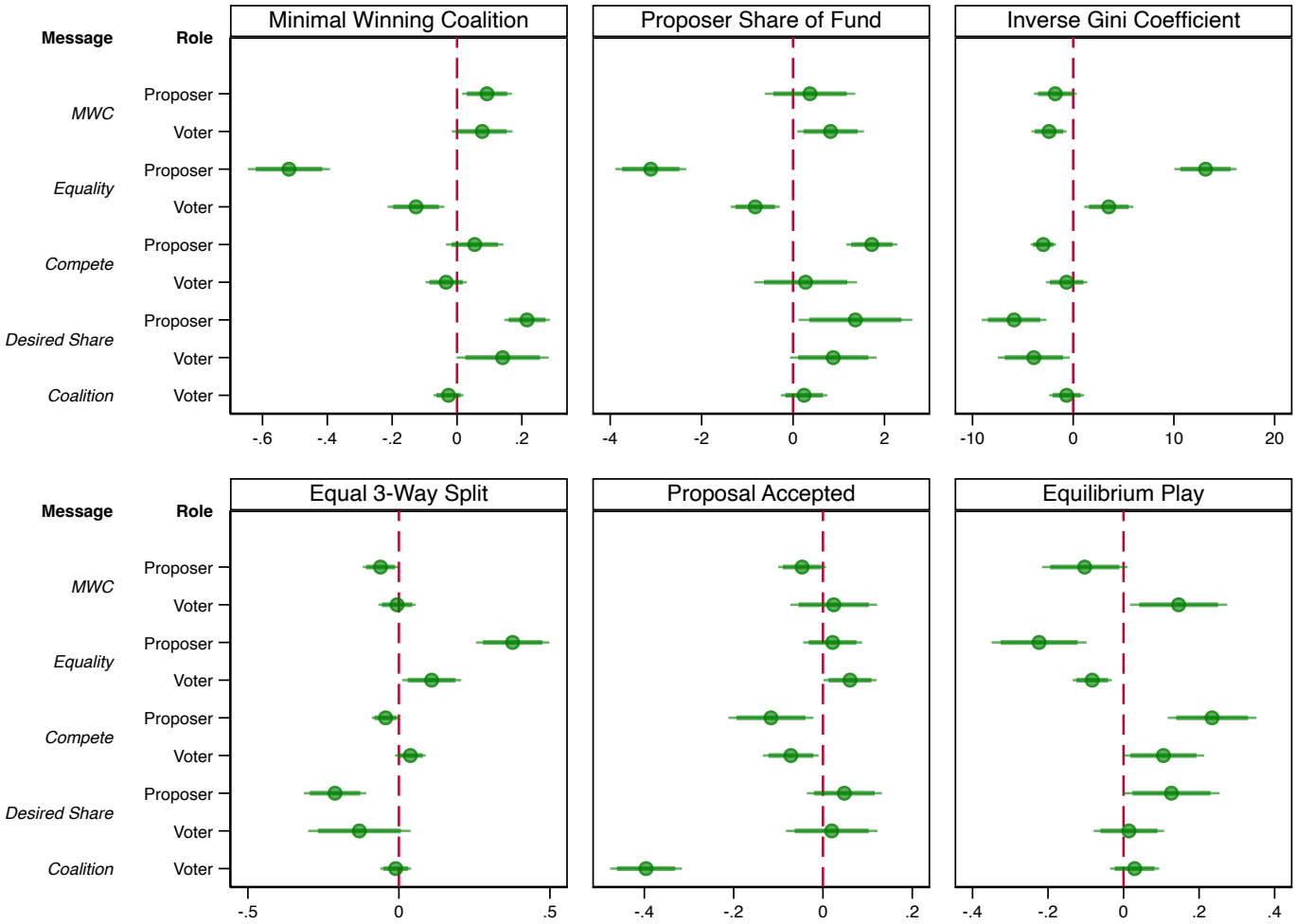
[14] In order to present results pooling across both treatments, we do not include convince to accept and convince to reject categories, which were only coded for the *P&V-Chat* treatment. See Appendix Table C3 for an analysis limited to the *P&V-Chat* treatment and including these two categories.

[15] These relationships are all statistically distinguishable from zero (see Appendix Table C2).

[16] We further observe correspondence between communication content and bargaining outcomes where we consider communication and outcomes for specific voters and proposers. For instance, we find that where MWCs are proposed and were discussed between a proposer and *only* voter 1 or voter 2, they are more likely to be formed with the specific voter with whom MWCs were discussed (see Appendix Figure C1).

[17] See Appendix Section C for a similar analysis considering discussion of punishing the previous round's proposer. We present discussion of coalitions in the main text due to the substantially larger number of observations; recall that since punishment concerned previous round behavior, it was only coded for bargaining rounds beyond one.

[18] Results are statistically distinguishable from zero, see Appendix Table C5.



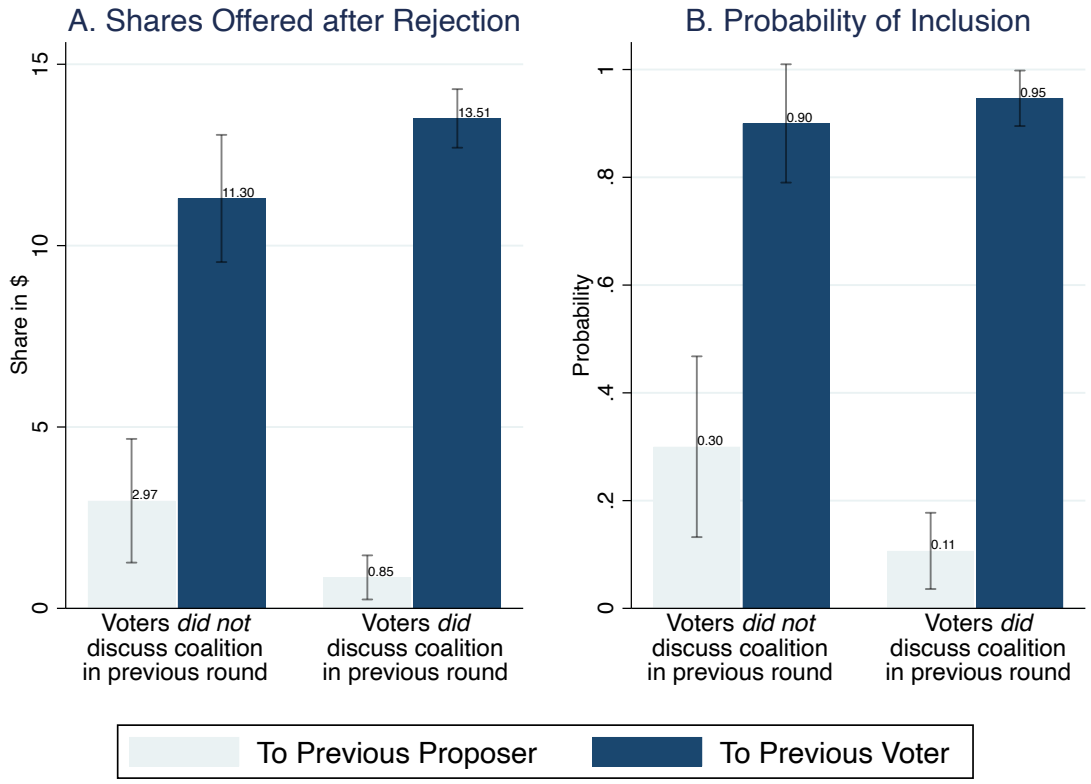
Notes: This figure displays the relationship between whether a type of communication was coded by a majority of coders as having occurred, and bargaining outcomes (MWC, the proposer's share of the fund, equality as measured by a Gini coefficient and occurrence of three-way splits, whether a proposal was accepted, and whether there was equilibrium play), in a given round of play. We distinguish between whether a proposer or voter was coded as having sent a message on a given topic for all topics with the exception of future coalitions, which was only coded for voters. We cluster standard errors at the subject and session levels, only consider communication at the proposal stage, and we control for treatment assignment. We exclude punishment from the analysis because, unlike the other content categories, it concerns communication about previous round behavior and thus is only coded for rounds greater than one; see Appendix Section C for an analysis of communication about punishment and bargaining outcomes.

Figure 5: **Communication Content and Bargaining Outcomes**

and whether a MWC was proposed is positive across treatment conditions, but not differentially so.

7 Discussion and Concluding Remarks

In this study we have explored how the timing of communication in a majoritarian structured bargaining game impacts bargaining outcomes and processes. We study a canonical model by Baron



Notes: Panel A shows the mean share that is offered in round t to players disaggregated by a) their role in round $t-1$ and b) whether voters in their group discussed forming a future coalition in round $t-1$. Failed proposers receive lower shares than those who were voters in the preceding round, particularly where voters had discussed forming a future coalition in that round. We only include proposals by subjects that did not propose in the preceding round and exclude the share that they are demanding for themselves. In Panel B we show the proportion of times a member receives a positive share (i.e. is included in the coalition). Both panels include 95% confidence intervals.

Figure 6: **Discussion of Coalition and History-Dependent Behavior**

and Ferejohn (1989) in which theory predicts no impact of communication on equilibrium play, yet previous studies of communication at the proposal stage by Agranov and Tergiman (2014) and Baranski and Kagel (2015) have reported an increase in proposer power and the overall adherence to equilibrium prediction. In our experiment, we additionally show that where communication is introduced at the voting stage, equilibrium play and proposer power falls in between the baseline treatment without communication and the treatment with communication at the proposal stage only. Importantly, allowing for communication at the voting stage leads to reaching agreements earlier compared to communication only at the proposal stage. As such, we conclude that the timing of communication shapes bargaining outcomes.

Our second finding concerns the effect of communication on the bargaining process. Theoretically, there should be no delay in reaching an agreement, but what happens when subjects disagree?

The stationary subgame perfect equilibrium prediction, which is necessary to yield a unique equilibrium outcome, assumes that bargaining behavior is not path dependent. This means that the history of play is irrelevant at the beginning of each new bargaining round following a disagreement. We provide stark evidence against stationarity: Subjects retaliate against failed proposers. More importantly, when communication is possible, retaliation is significantly stronger. It is thus incorrect to conclude that communication leads to stationary behavior in bargaining because, even if outcomes are closer to equilibrium when chat at the proposal stage is allowed, strategies employed exhibit strong path dependence.

Experiments investigating the role of costless communication in majoritarian bargaining *à la* Baron and Ferejohn are scarce, which makes replication efforts quite important. While we reproduce the central previous finding that proposer power is larger under communication (at the proposal stage) compared to no communication games, the magnitude of the effect is smaller in our sample. This certainly calls for more work to be done in order to understand which factors may drive subject- and sample-level differences in bargaining behavior, such as socio-demographic characteristics, culture, personality traits, cognitive abilities, and political views, among others.

However, we ask, are there any robust patterns of behavior emerging in majoritarian bargaining experiments? Four of our findings are shared with the closely-related investigations by Agranov and Tergiman (2014) and Baranski and Kagel (2015). First, communication serves as a coordination mechanism through which proposers are able to identify voters' *preferences* and secure passage of their proposals. Evidence of this is that round-one agreement rates are always higher compared to treatments absent communication and that subjects very often reveal their *reservation shares*. Second, communication content is correlated with bargaining outcomes. Despite differences across studies in the coding and analysis of messages, it is evident that *cheap talk* systematically affects the distribution of the surplus. Third, *competitive* or *selfish* messages (i.e. calling for the formation of a minimum winning coalition or pitting players against each other) are more prevalent than messages about *fairness* and equitable sharing. Fourth, private communication channels between two parties are preferred over public channels, and when public channels are used, it is almost exclusively to lobby for *fairness*.

Some open questions remain to be explored. For example, little is known about what role communication plays in the midst of asymmetries, which are ubiquitous in negotiations (Maaser et al.,

2019). Bargaining may also occur over multiple issues (Bochet et al., 2020) and communication may allow for compromise in policy domains (Baranski et al., 2022). Moreover, the Baron and Ferejohn game, despite being quite popular, is one of many bargaining protocols. Subject behavior under alternative negotiation rules such as those developed by Krishna and Serrano (1996) with exit upon agreement or Kim (2019) in which proposers have only one shot at making a proposal is widely unexplored (with and without communication). Thus, only further experiments can shed light on the generalizability of the findings reported here.

REFERENCES

Agranov, M. (2020). Legislative bargaining experiments. Private communication with the author. To appear in "Bargaining: Current Research and Future Directions" edited by Emin Karagozoglu and Kyle Hyndman.

Agranov, M., Cotton, C., and Tergiman, C. (2020a). Persistence of power: Repeated multilateral bargaining with endogenous agenda setting authority. *Journal of Public Economics*, 184:104126.

Agranov, M., Eraslan, H., and Tergiman, C. (2020b). Bargaining in the shadow of uncertainty. *Working Paper*.

Agranov, M. and Tergiman, C. (2014). Communication in multilateral bargaining. *Journal of Public Economics*, 118:75–85.

Agranov, M. and Tergiman, C. (2019). Communication in bargaining games with unanimity. *Experimental Economics*, 22(2):350–368.

Arad, A., Grubiak, K., and Penczynski, S. P. (2021). Does communicating within a team influence individuals' reasoning and decisions? Mimeo. Retrieved from `http://www.penczynski.de/research.htm`. Last accessed May 18, 2022.

Backus, M., Blake, T., Larsen, B., and Tadelis, S. (2020). Sequential bargaining in the field: Evidence from millions of online bargaining interactions. *The Quarterly Journal of Economics*, 135(3):1319–1361.

Baranski, A. and Cox, C. (in press). Communication in multilateral bargaining with joint production. *Experimental Economics*.

Baranski, A., Haas, N., and Morton, R. (2022). Pork versus policy: Experimental evidence on majoritarian bargaining with real-world consequences. `https://www.abarmad.com/research.html`. Accessed: April 25, 2022.

Baranski, A. and Kagel, J. H. (2015). Communication in legislative bargaining. *Journal of the Economic Science Association*, 1(1):59–71.

Baranski, A. and Morton, R. (in press). The determinants of multilateral bargaining: A comprehensive analysis of Baron and Ferejohn majoritarian bargaining experiments. *Experimental Economics*.

Baron, D. P., Bowen, T. R., and Nunnari, S. (2017). Durable coalitions and communication: Public versus private negotiations. *Journal of Public Economics*, 156:1–13.

Baron, D. P. and Ferejohn, J. A. (1989). Bargaining in legislatures. *American political science review*, 83(4):1181–1206.

Baturo, A., Dasandi, N., and Mikhaylov, S. J. (2017). Understanding state preferences with text as data: Introducing the un general debate corpus. *Research & Politics*, 4(2):2053168017712821.

Bochet, O., Khanna, M., and Siegenthaler, S. (2020). Beyond dividing the pie: Multi-issue bargaining in the laboratory. *Available at SSRN 3414288*.

Bochet, O., Page, T., and Putterman, L. (2006). Communication and punishment in voluntary contribution experiments. *Journal of Economic Behavior & Organization*, 60(1):11–26.

Bolton, G. E. and Brosig-Koch, J. E. (2012). How do coalitions get built? Evidence from an extensive form coalition game with and without communication. *International Journal of Game Theory*, 41(3):623–649.

Bolton, G. E., Chatterjee, K., and McGinn, K. L. (2003). How communication links influence coalition bargaining: A laboratory investigation. *Management Science*, 49(5):583–598.

Bolton, G. E. and Karagözoğlu, E. (2016). On the influence of hard leverage in a soft leverage bargaining game: The importance of credible claims. *Games and Economic Behavior*, 99:164–179.

Bradfield, A. J. and Kagel, J. H. (2015). Legislative bargaining with teams. *Games and Economic Behavior*, 93:117–127.

Brandts, J., Cooper, D. J., and Rott, C. (2019). Communication in laboratory experiments. In *Handbook of research methods and applications in experimental economics*. Edward Elgar Publishing.

Bressanelli, E., Koop, C., and Reh, C. (2016). The impact of informalisation: Early agreements and voting cohesion in the european parliament. *European Union Politics*, 17(1):91–113.

Broniecki, P. (2020). Power and transparency in political negotiations. *European Union Politics*, 21(1):109–129.

Cason, T. N., Sheremeta, R. M., and Zhang, J. (2012). Communication and efficiency in competitive coordination games. *Games and Economic Behavior*, 76(1):26–43.

Charness, G. (2000). Self-serving cheap talk: A test of aumann's conjecture. *Games and Economic Behavior*, 33(2):177–194.

Chessa, M., Hanaki, N., Lardon, A., and Yamada, T. (2021). An experiment on the winter demand commitment bargaining mechanism. *ISER DP*, (1152).

Cooper, D. J. and Kagel, J. H. (2005). Are two heads better than one? team versus individual play in signaling games. *American Economic Review*, 95(3):477–509.

Cox, C. A. and Stoddard, B. (2018). Strategic thinking in public goods games with teams. *Journal of Public Economics*, 161:31–43.

Duffy, J. and Feltovich, N. (2002). Do actions speak louder than words? An experimental comparison of observation and cheap talk. *Games and Economic Behavior*, 39(1):1–27.

Eraslan, H. (2002). Uniqueness of stationary equilibrium payoffs in the Baron–Ferejohn model. *Journal of Economic Theory*, 103(1):11–30.

Gächter, S. and Riedl, A. (2005). Moral property rights in bargaining with infeasible claims. *Management Science*, 51(2):249–263.

Gächter, S. and Riedl, A. (2006). Dividing justly in bargaining problems with claims. *Social Choice and Welfare*, 27(3):571–594.

Gangadharan, L., Nikiforakis, N., and Villeval, M. C. (2017). Normative conflict and the limits of self-governance in heterogeneous populations. *European Economic Review*, 100:143–156.

Gantner, A., Horn, K., and Kerschbamer, R. (2019). The role of communication in fair division with subjective claims. *Journal of Economic Behavior & Organization*, 167:72–89.

Herings, P. J. J., Meshalkin, A., and Predtetchinski, A. (2018). Subgame perfect equilibria in majoritarian bargaining. *Journal of Mathematical Economics*, 76:101–112.

Karagözoğlu, E. and Kocher, M. G. (2019). Bargaining under time pressure from deadlines. *Experimental Economics*, 22(2):419–440.

Kim, D. G. (2019). Recognition without replacement in legislative bargaining. *Games and Economic Behavior*, 118:161–175.

Koch, C., Nikiforakis, N., and Noussair, C. N. (2021). Covenants before the swords: The limits to efficient cooperation in heterogeneous groups. *Journal of Economic Behavior & Organization*, 188:307–321.

Krishna, V. and Serrano, R. (1996). Multilateral bargaining. *The Review of Economic Studies*, 63(1):61–80.

Landis, J. R. and Koch, G. G. (1977). The measurement of observer agreement for categorical data. *biometrics*, pages 159–174.

Lo Bianco, S. and Princen, S. B. (2019). How strong is deliberation in eu intergovernmental decision making? deliberation in the field of justice and home affairs. *Journal of European Integration*, 41(6):729–744.

Maaser, N., Paetzel, F., and Traub, S. (2019). Power illusion in coalitional bargaining: An experimental analysis. *Games and Economic Behavior*, 117:433–450.

Martinelli, C. and Palfrey, T. R. (2020). Communication and information in games of collective decision: A survey of experimental results. In *Handbook of Experimental Game Theory*. Edward Elgar Publishing.

Naurin, D. (2007). Backstage behavior? lobbyists in public and private settings in sweden and the european union. *Comparative Politics*, pages 209–228.

Naurin, D. (2010). Most common when least important: deliberation in the european union council of ministers. *British Journal of Political Science*, 40(1):31–50.

Ochs, J. and Roth, A. E. (1989). An experimental study of sequential bargaining. *The American Economic Review*, pages 355–384.

Proksch, S.-O., Wratil, C., and Wäckerle, J. (2019). Testing the validity of automatic speech recognition for political text analysis. *Political Analysis*, 27(3):339–359.

Sally, D. (1995). Conversation and cooperation in social dilemmas: A meta-analysis of experiments from 1958 to 1992. *Rationality and society*, 7(1):58–92.

Stasavage, D. (2004). Open-door or closed-door? transparency in domestic and international bargaining. *International organization*, 58(4):667–703.

Wratil, C. and Hobolt, S. B. (2019). Public deliberations in the council of the european union: Introducing and validating diceu. *European Union Politics*, 20(3):511–531.

Online Appendix for

The Timing of Communication and Retaliation in Bargaining: An Experimental Study

by Andrzej Baranski and Nicholas Haas

Table of Contents

A Additional Information on Content Coding

Chat Coding Instructions for Research Assistants

General Description of the Task

You will be reading over conversations between members of a group that were bargaining to divide a given amount of money among themselves. These group members were participants in an experiment that took place between January and April of 2020 in [redacted].

In the experiment, one subject of the group was selected to be the person who would divides $30 among himself and two other members. Subjects had up to 3 minutes to chat with the other two members. Proposers had to choose a distribution of the fund and once they did so, the remaining members would proceed to a vote. In some of our experimental sessions, subjects were allowed to keep chatting during the voting stage, while in other sessions this was not allowed. We also conducted sessions where chat only occurred at the voting stage. If a majority approved the proposal, then the proposal was binding. If not, the process would repeat itself until approval. Thus, potentially a same group could negotiate for several rounds.

A copy of the experimental instructions has been given to you. Please read them thoroughly.

Details of the Coding Task

You will be shown the chat transcripts for different groups. Each chat will have three windows, since each person could communicate privately with another member or publicly with all members.

Under each window, there will be several categories that you should mark in case it applies to the conversation in that window. The categories are:

1. **Irrelevant:** when **all** the messages are unrelated to the task. Examples would be conversations where only greetings are exchanged.
2. **All-way split:** whenever a member states that the total fund should be split between all three members, that is, that all members should get something. “I will give everyone something” or members tell the proposer “you should share it with both of us”. Calling for a 3-way equal split, $10 for each, is also to be coded here.
3. **Minimum Winning Coalition:** whenever a proposer mentions that he will only give money to one of the voters. When a voting member explicitly or implicitly tells the proposer that the other member should get zero. Similar phrasing may be used like: “I’m fine with the other person getting 0”; “I don’t care if you give money to the other member”; “Let’s split us two in half”; “let’s go you and I 50-50”. “Me 13, you keep the rest”.
4. **Competition:** whenever the proposer tells a voter the amount that the other voter is willing to accept. Also marked if the proposer tells a voter that the other voter is willing to accept less, or that she is looking for the cheapest voter. For voters, whenever he or she asks how much the other one is willing to accept and seeks to undercut or match. “I will take less than the other person” or “I will match the other person”.
5. **Desired Share:** whenever a member states how much he or she will accept. If there are several instances during the conversation in which a desired share is expressed, only record the latest one. This should be expressed in dollars. Sometimes subjects ask for a percentage “give me 50%”, or as “give me half” if so, the amount is converted this to tokens and rounded

to the nearest decimal. If the proposer offers amount "X" and the voter says "yes that is fine" then X should be recorded. Record only the last amount agreed.

6. **Future Coalition:** when non-proposers attempt to strike a deal of a future coalition. "We should reject and next round we split it in half between of ourselves". "We should reject and figure it out between both of us next round" "The proposer is trying to give us a small share, lets reject and divide ourselves".
7. **Punishment of previous round proposer:** whenever it is mentioned that the previous proposer should receive a lower share or nothing. Also, if there is a discussion of retaliation or punishment toward the previous proposer. This category is only available for chat in bargaining in rounds 2 or greater (when there has been a rejection).

Categories at the voting stage:

8. **Convince to reject:** when a member seeks to convince another member to vote against
9. **Convince to accept:** when a member seeks to convince another member to accept
10. **Future Coalition:** when non-proposers attempt to strike a deal of a future coalition. "We should reject and next round we propose split it in half". "We should reject and figure it out between both of us next round" "The proposer is trying to give us a small share, lets reject and divide ourselves".

B Experimental Instructions for Proposal & Voting Chat Treatment

Experiment Instructions

This is an experiment in the economics of decision making. We follow a no-deception ethical policy at the Economics Lab, hence these instructions fully describe the experiment.

A Brief Overview of the Experiment

In this experiment you will be part of a group of 3 people. One of you will be asked to propose a distribution of $30 among the members of your group. Group members will be able to communicate with each other through chat screens. Proposals are voted up or down according to the simple majority rule. In case the current proposal is rejected, the members of the same group proceed to another proposal and voting round until one allocation is approved. The details of the experiment follow.

The Details of the Experiment

As expressed above, this experiment involves three main components: **(1) chat, (2) proposal, and (3) vote.** We proceed to fully explain each of them.

(1) Chat

The computer will randomly choose one of you to be the proposer of a distribution of $30. Before a proposal is made, you will have up to three minutes during which time you can exchange written messages with the other two members of your group. Messages can be sent to each member of your group individually through a private chat screen and also collectively through a public chat screen which the other two members can see. The chat screen will remain open during both proposing and voting stages of bargaining, explained below. We ask that you please be respectful of others and do not reveal your identity or personal information while chatting.

(2) Proposal

In this stage the proposer submits a division of the $30.

(3) Voting

You will observe how much the proposer assigned to each member of the group. You can then click "accept" or "reject". For approval, the proposal requires a simple majority (at least 2 votes). The proposer will automatically be counted as a voting in favor.

If rejected: every member in your group will proceed to stage (2) with a member randomly selected as proposer. Feedback on the previous proposal, the voting result, and who was the proposer will be given to you.

The process repeats itself until an allocation of the total fund is approved.

If approved: the result will be binding. Next, you will then be matched into new groups to repeat the stages (1)-(3). You will participate in a total of 15 periods. In each period, you will be randomly reassigned into a group of 3 people, with your subject number for each period determined randomly as well. Thus, while your subject number will remain the same for all rounds *within* a given period, it will change across periods: in period 1 you can be subject 3, and in period 2 you can be subject 1.

Your Earnings

Only 2 of the 15 periods will be randomly selected to count for payment. Your earnings (E) are then given by the shares you received in those periods plus the show up fee of $10.

Are there any questions so far?

Example.

Below, we provide an example for you to understand how the payoffs of the experiment work.

Consider a 3 person group with $30 to divide. The proposer allocates $8 to subject 1, $5 to herself, and $17 to subject 2. If Subject 1 votes in favor and Subject 2 against (the proposer is automatically counted in favor), then the proposal is approved. The payments subjects would receive if this period was selected for payment are the offered shares in the approved proposal. Note however that votes could have been different in which case a new round would take place.

Are there any questions?

Review of the experiment

1. Everyone is randomly assigned into groups of 3
2. There are $30 to divide.
3. One of you will be randomly chosen as the proposer.
4. You will have up to three minutes to chat while the proposer enters a division of the money and up to three minutes to chat while a voting decision is reached.
5. Be respectful and do not reveal any personal information while chatting.
6. Once a proposal is made, voting will take place. If a majority accepts, the allocation is binding, and you will wait in standby until the other groups in your session decide on an allocation.
7. If a majority rejects, the process repeats itself until a given allocation is accepted.
8. Once an allocation is accepted, you will start a new period with randomly selected members. 2 of the 15 periods of play will be chosen randomly for payment.

What should you do? If we knew the answer to this question, we would not need to run an experiment.

C Additional Results and Regressions

	(1) MWC	(2) Equality	(3) Compete	(4) Punish	(5) Con Accept	(6) Con Reject
Panel A: Communication Channel						
Reference: Proposer & Voter (Private)						
Public	-0.74***	0.15**	-0.17**	-0.03	-0.01	0.00
	(0.04)	(0.03)	(0.04)	(0.01)	(0.01)	(0.01)
Between Voters	-	-	-	0.00	-0.01	0.08*
	-	-	-	(0.02)	(0.01)	(0.03)
N	1,718	1,718	1,718	474	1,479	1,479
Panel B: Communicator Type						
Reference: Proposer						
Voter	0.11*	0.07**	-0.05	0.01	-0.01	0.05**
	(0.03)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
N	2,577	2,577	2,577	474	1,479	1,479
Panel C: Treatment Assignment						
Reference: Chat Proposal Stage						
Chat Proposal & Voting Stages	-0.01	0.07	0.07	0.02	-	-
	(0.07)	(0.08)	(0.07)	(0.04)	-	-
N	859	859	859	158	N/A	N/A
Panel D: Type X Treatment						
Voter	0.10*	0.07***	-0.02*	0.01	-	-
	(0.03)	(0.01)	(0.01)	(0.02)	-	-
Chat Proposal & Voting Stages	0.01	0.04	0.08	0.00	-	-
	(0.06)	(0.03)	(0.05)	(0.02)	-	-
Voter X Chat P&V	0.02	-0.01	-0.05	0.01	-	-
	(0.06)	(0.03)	(0.03)	(0.03)	-	-
N	2,577	2,577	2,577	474	N/A	N/A

* p<0.05, ** p<0.01, *** p<0.001

Notes: This table displays the relationship between communication channel (panel A), communicator type (panel B), treatment assignment (panel C), and type and treatment assignment (panel D), and whether a given communication content category was coded by a majority of coders as having occurred in a given round of bargaining. We cluster standard errors at the subject and session levels. In Panels A and B, we control for treatment assignment (either *Proposal Only* or *Proposal & Voting*). Analysis only considers communication at the proposal stage, except for the convince accept and reject categories, which were only coded for the voting stage and thus can only be displayed for the *Proposal & Voting* Treatment. The punishment content category, which concerns punishment of previous round behavior, was only coded for rounds beyond the first round.

Table C1: Regression Results Corresponding to Figures 2 and 3

	Dependent Variable:					
Content (Sender):	(1)	(2)	(3)	(4)	(5)	(6)
	MWC	Proposer Share	Inverse Gini	Equal 3-Way	Acceptance	Equilibrium
MWC (Proposer)	0.09*	0.37	-1.78	-0.06*	-0.05	-0.10
	(0.03)	(0.44)	(0.94)	(0.03)	(0.02)	(0.05)
MWC (Voter)	0.08	0.82*	-2.40*	-0.01	0.02	0.15*
	(0.04)	(0.32)	(0.77)	(0.03)	(0.04)	(0.06)
Equality (Proposer)	-0.52***	-3.11***	13.14***	0.38***	0.02	-0.22**
	(0.06)	(0.34)	(1.36)	(0.05)	(0.03)	(0.06)
Equality (Voter)	-0.13**	-0.83**	3.53**	0.11*	0.06*	-0.08**
	(0.04)	(0.24)	(1.08)	(0.04)	(0.03)	(0.02)
Compete (Proposer)	0.05	1.72***	-2.97***	-0.04	-0.12*	0.23**
	(0.04)	(0.25)	(0.55)	(0.02)	(0.04)	(0.05)
Compete (Voter)	-0.03	0.27	-0.65	0.04	-0.07*	0.11
	(0.03)	(0.50)	(0.91)	(0.02)	(0.03)	(0.05)
Desired Share (Proposer)	0.22***	1.36*	-5.87**	-0.21**	0.05	0.13
	(0.03)	(0.55)	(1.42)	(0.05)	(0.04)	(0.06)
Desired Share (Voter)	0.14	0.88	-3.91*	-0.13	0.02	0.01
	(0.06)	(0.42)	(1.58)	(0.07)	(0.05)	(0.04)
Coalition (Voter)	-0.03	0.24	-0.65	-0.01	-0.40***	0.03
	(0.02)	(0.22)	(0.76)	(0.02)	(0.04)	(0.03)
N	859	859	859	859	859	859

* p<0.05, ** p<0.01, *** p<0.001

Notes: This table displays the relationship between whether a type of communication was coded by a majority of coders as having occurred, and bargaining outcomes (MWC, the proposer's share of the fund, equality as measured by a Gini coefficient and occurrence of three-way splits, whether a proposal was accepted, and whether there was equilibrium play), in a given round of play. We distinguish between whether a proposer or voter was coded as having sent a message on a given topic for all topics with the exception of future coalitions, which was only coded for voters. We cluster standard errors at the subject and session levels, only consider communication at the proposal stage, and we control for treatment assignment.

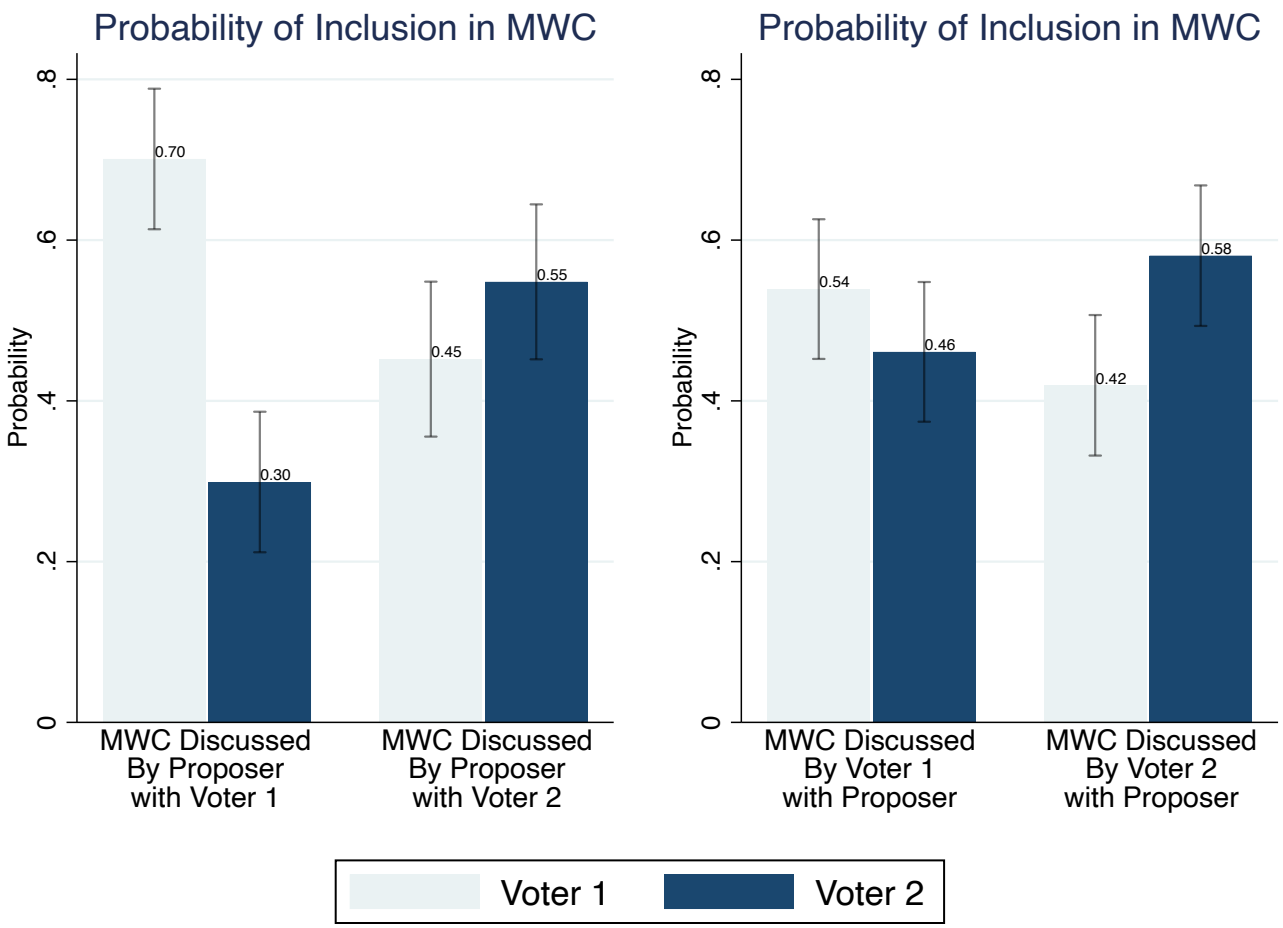
Table C2: Regression Results Corresponding to Figure 5

	Dependent Variable:					
Content (Sender):	(1)	(2)	(3)	(4)	(5)	(6)
	MWC	Proposer Share	Inverse Gini	Equal 3-Way	Acceptance	Equilibrium
MWC (Proposer)	0.13*	0.55	-2.33	-0.09	-0.05	-0.07
	(0.05)	(0.60)	(1.39)	(0.04)	(0.03)	(0.08)
MWC (Voter)	0.10*	1.15*	-2.89*	-0.03	0.01	0.17
	(0.03)	(0.37)	(0.90)	(0.04)	(0.03)	(0.08)
Equality (Proposer)	-0.46**	-2.83***	12.40**	0.38**	0.04	-0.15*
	(0.08)	(0.40)	(1.85)	(0.06)	(0.04)	(0.05)
Equality (Voter)	-0.14	-1.02*	4.41*	0.14*	0.06*	-0.06
	(0.06)	(0.37)	(1.43)	(0.05)	(0.02)	(0.03)
Compete (Proposer)	0.06	1.99**	-3.47**	-0.05	-0.07	0.25**
	(0.04)	(0.33)	(0.65)	(0.03)	(0.04)	(0.06)
Compete (Voter)	-0.03	-0.06	-0.49	0.02	-0.08	0.11
	(0.04)	(0.72)	(1.31)	(0.03)	(0.04)	(0.08)
Conv Accept (Proposer)	0.15**	3.57***	-10.19**	-0.24**	-0.01	-0.02
	(0.03)	(0.50)	(1.62)	(0.04)	(0.05)	(0.13)
Conv Accept (Voter)	-0.18	-1.62*	6.94*	0.31*	0.14	-0.08*
	(0.08)	(0.50)	(2.19)	(0.09)	(0.08)	(0.03)
Conv Reject (Proposer)	-0.10	-1.10	4.19	0.19	0.00	-0.04
	(0.06)	(0.60)	(2.07)	(0.08)	(0.02)	(0.03)
Conv Reject (Voter)	-0.03	-0.20	0.78	0.06*	-0.20	0.03
	(0.02)	(0.29)	(0.51)	(0.02)	(0.11)	(0.03)
Desired Share (Proposer)	0.24**	1.35	-6.43*	-0.24**	0.02	0.11
	(0.04)	(0.65)	(2.07)	(0.06)	(0.04)	(0.09)
Desired Share (Voter)	0.12	0.75	-3.17	-0.10	0.07	0.02
	(0.07)	(0.51)	(2.05)	(0.09)	(0.04)	(0.05)
Coalition (Voter)	-0.04	-0.05	0.45	0.01	-0.38***	0.02
	(0.03)	(0.19)	(0.77)	(0.04)	(0.03)	(0.03)

* p<0.05, ** p<0.01, *** p<0.001

Notes: This table displays the relationship between whether a type of communication was coded by a majority of coders as having occurred, and bargaining outcomes (MWC, the proposer's share of the fund, equality as measured by a Gini coefficient and occurrence of three-way splits, whether a proposal was accepted, and whether there was equilibrium play), in a given round of play. We distinguish between whether a proposer or voter was coded as having sent a message on a given topic for all topics with the exception of future coalitions, which was only coded for voters. We cluster standard errors at the subject and session levels. Because we consider two content categories (convince accept and convince reject) only coded at the voting stage, we present results only for the *Proposal & Voting* treatment. All other variables refer to communication at the proposal stage.

Table C3: Figure 5 Regression Including Voting Stage Content (*Proposal & Voting* treatment only)



Notes: Panel A shows the probability that voter 1 or voter 2 was included in a MWC, based on whether a proposer initiated a discussion of the MWC with either *only* voter 1 or *only* voter 2. Panel B shows the same probabilities, but based on whether a voter initiated the relevant discussion. We limit our analysis to cases where a MWC was ultimately formed and where MWC discussion occurred between proposers and only voter 1 or only voter 2. Both panels include 95% confidence intervals.

Figure C1: **MWC Formation by Discussion and Partner**

	Proposed Shares to:		Probability of Inclusion for:	
	(1)	(2)	(3)	(4)
	Previous Proposer	Previous Voter	Previous Proposer	Previous Voter
Coalition Discussed Previously	-2.27	2.21	-0.22	0.05
	(1.03)	(0.97)	(0.11)	(0.05)
N	105	105	105	105

* p<0.05, ** p<0.01, *** p<0.001

Notes: This table displays the relationship between whether voters discussed forming a coalition in round $t-1$ and the mean share offered (columns 1 and 2) and probability of inclusion in a coalition (columns 3 and 4) in round t for voters (columns 2 and 4) and proposers (columns 1 and 3) in round $t-1$. We only include proposals by subjects that did not propose in the preceding round and exclude the share that they are demanding for themselves. We cluster standard errors at the subject and session levels, only consider communication at the proposal stage, and we control for treatment assignment.

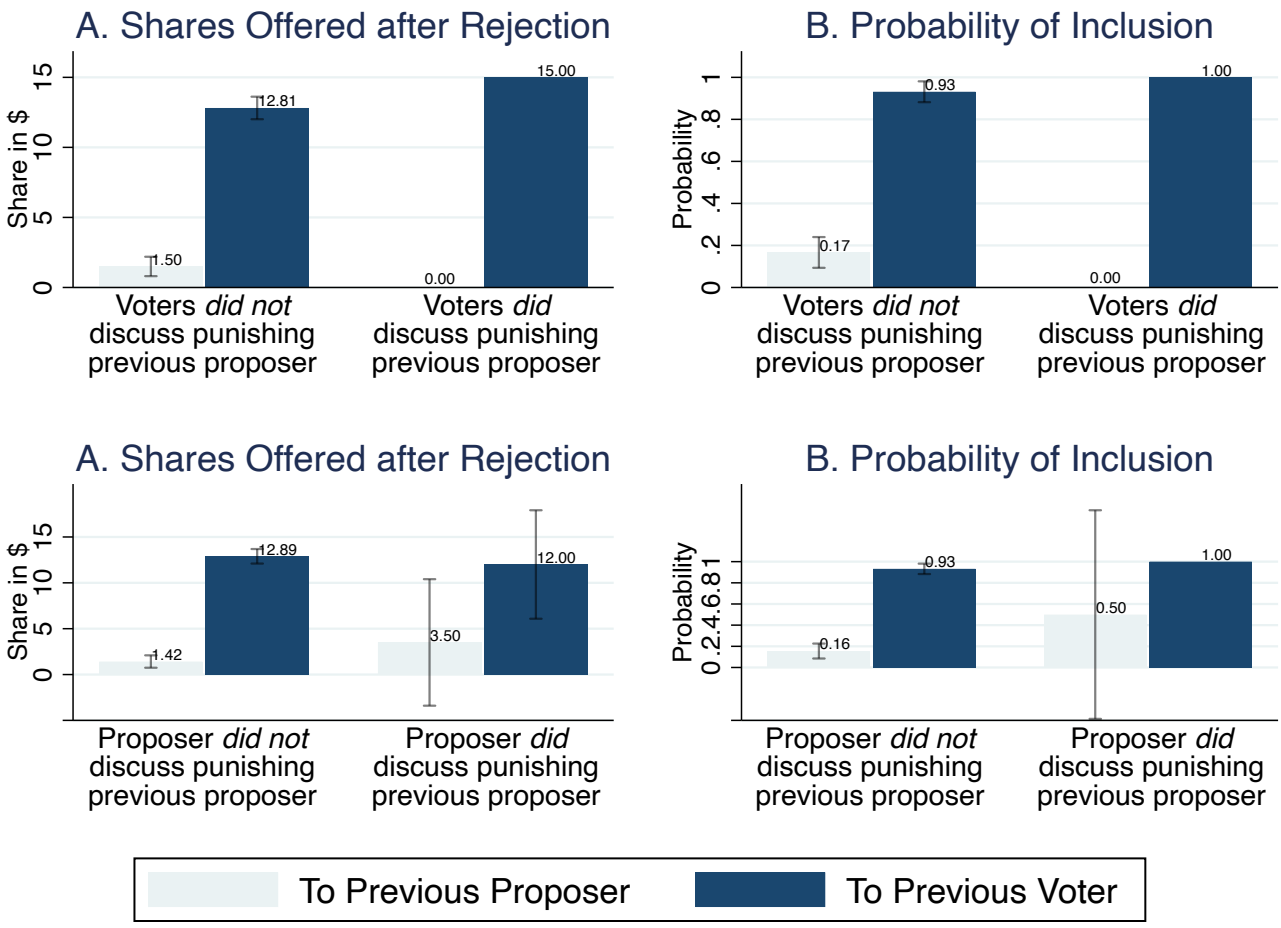
Table C4: Regression Results Corresponding to Figure 6

	(1)	(2)
	Proposed Share	Probability of Inclusion
Coalition Discussed Previously	-6.51*	-0.45
	(2.73)	(0.22)
To/For: Previous Voter	8.33**	0.60***
	(1.66)	(0.11)
Coalition X Prev Voter	4.32*	0.24
	(1.80)	(0.12)
N	210	210

* p<0.05, ** p<0.01, *** p<0.001

Notes: This table displays the relationship between whether voters discussed forming a coalition in round $t-1$, whether the proposal considered concerns the voter or proposer from round $t-1$, and the interaction between the two, and the proposed share (column 1) or probability of inclusion (column 2) for either the previous round's voter or proposer. We only include proposals by subjects that did not propose in the preceding round and exclude the share that they are demanding for themselves. We cluster standard errors at the subject and session levels, only consider communication at the proposal stage, and we control for treatment assignment.

Table C5: Regression Results Corresponding to Figure 6 (Interaction)



Notes: Panel A shows the mean share that is offered in round t to players disaggregated by a) their role in round $t-1$ and b) whether voters (top figures) or proposers (bottom figures) in their group discussed in round t punishing the previous round's proposer. We only include proposals by subjects that did not propose in the preceding round and exclude the share that they are demanding for themselves. In Panel B we show the proportion of times a member receives a positive share (i.e. is included in the coalition). Both panels include 95% confidence intervals.

Figure C2: **Discussion of Punishment and History-Dependent Behavior**

	Proposed Shares to:		Probability of Inclusion for:	
	(1)	(2)	(3)	(4)
	Previous Proposer	Previous Voter	Previous Proposer	Previous Voter
Voters Discussed Punishing	-1.47*	2.08*	-0.17*	0.07
Prev Proposer	(0.59)	(0.64)	(0.06)	(0.04)
Proposer Discussed Punishing	2.04	-0.85	0.34	0.07
Prev Proposer	(3.07)	(2.93)	(0.40)	(0.03)
N	105	105	105	105

* p<0.05, ** p<0.01, *** p<0.001

Notes: This table displays the relationship between whether voters or proposers discussed in round t punishing the proposer from round $t-1$ and the mean share offered (columns 1 and 2) and probability of inclusion in a coalition (columns 3 and 4) in round t for voters (columns 2 and 4) and proposers (columns 1 and 3) in round $t-1$. We only include proposals by subjects that did not propose in the preceding round and exclude the share that they are demanding for themselves. We cluster standard errors at the subject and session levels, only consider communication at the proposal stage, and we control for treatment assignment.

Table C6: Regression Results Corresponding to Figure C2

	Proposed Shares		Probability of Inclusion	
	(1)	(2)	(3)	(4)
To/For: Previous Voter	11.31***	11.48***	0.76***	0.78***
	(0.99)	(1.03)	(0.07)	(0.07)
Proposer Discussed Punishing Prev Proposer		5.05		0.62
		(8.77)		(0.84)
Voters Discussed Punishing Prev Proposer	-5.24**		-0.41**	
	(1.49)		(0.12)	
Proposer Punish X Prev Voter		-2.98		-0.28
		(5.80)		(0.43)
Voters Punish X Prev Voter	3.69**		0.24*	
	(0.99)		(0.07)	
N	210	210	210	210

* p<0.05, ** p<0.01, *** p<0.001

Notes: This table displays the relationship between whether voters or proposers discussed in round t punishing the proposer from round $t-1$, whether the proposal considered concerns the voter or proposer from round $t-1$, and the interaction between the two, and the proposed share (columns 1 and 2) or probability of inclusion (column 3 and 4) for either the previous round's voter or proposer. We only include proposals by subjects that did not propose in the preceding round and exclude the share that they are demanding for themselves. We cluster standard errors at the subject and session levels, only consider communication at the proposal stage, and we control for treatment assignment.

Table C7: Regression Results Corresponding to Figure C2 (Interaction)

	Proposal Acceptance
Coalition Proposal Stage	-0.39***
	(0.04)
Coalition Voting Stage	-0.20*
	(0.06)
N	859

* p<0.05, ** p<0.01, *** p<0.001

Notes: This table displays the relationship between the discussion of coalition formation at the proposal and the voting stage, respectively, and the likelihood of proposal acceptance. We cluster standard errors at the subject and session levels, only consider communication at the proposal stage, and we control for treatment assignment. A test of equality of coefficients yields $p = 0.06$.

Table C8: Discussion of Coalition by Stage, and Proposal Acceptance