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

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Abstract

We conduct an experiment to investigate how the timing of communication affects bargaining outcomes and dynamics in a majoritarian, sequential bargaining game. Our data show that allowing for free-form written communication at the proposal-making stage leads to higher proposer power and minimum winning coalitions compared to when communication is possible at the voting stage only. Absent communication, outcomes fall in between both communication timings. Voting patterns reveal that the timing of communication affects how subjects evaluate proposals, as they are more likely to vote in favor under proposal-stage communication than under voting-stage communication all else equal. In general, communication affects bargaining dynamics in that voters retaliate more strongly against failed proposers, compared to the no communication baseline. We provide a detailed description of communication content, the medium utilized to communicate, and how the volume and timing of messages affects outcomes. Our results underscore the importance of an in-depth analysis of processes and dynamics to understand bargaining behavior, because even when communication may lead to outcomes that resemble equilibrium, the strategies employed by subjects need not.

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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 counterparts 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.[2]

One area where studies using real-world data have advanced our understanding of the bargaining process is legislatures.[3] 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 bargainers 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] We use the terms communication "channel" and "medium" interchangeably.

[3] In recent years, scholars have sought to tackle a number of 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.[4]

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.[5]

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.

We randomly assign subjects to treatments where they either are not allowed to communicate at all, or are allowed to communicate at the proposal stage only, the voting stage only, or at both 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.

Several novel findings concerning outcomes and process emerge. First, regarding the distribution of the total fund to divide, we observe that the *timing* of communication has significant consequences for the agreements reached. Proposer power and the likelihood of minimum winning coalitions (MWCs) are greatest when communication is allowed at the proposal stage only and lowest when

[4]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.

[5]Recent studies that investigate bargaining processes include Gächter and Riedl (2006); 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 the Literature Review section for greater discussion.

it is allowed at the voting stage only. When communication is allowed at both stages behavior is quite close to when it is allowed only at the proposal stage, albeit proposer power is somewhat weaker.

Second, concerning the bargaining process, we find that subjects engage in retaliatory behavior by 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 games with communication compared to the no communication treatment. Importantly, this result runs contrary to the stationary subgame perfect equilibrium assumption, which is a universally adopted game-theoretic equilibrium refinement in the multi-stage bargaining literature (Eraslan and Evdokimov, 2019). Stationarity requires that proposed divisions of the fund are not path dependent. Thus, even if communication leads to more equilibrium outcomes, subjects need not reach those outcomes via the *theoretically assumed* processes.

Our study promises to make numerous contributions to the extant literature on communication in bargaining. 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 the voting stage only and at both the proposal and voting stages. We also code communication content at a more granular level than existing studies. For example, besides analyzing the content of messages, we investigate who communicates first, through which channels and to whom, and how such behavior impacts bargaining outcomes. Importantly, we also analyze how the formal bargaining proposal on the floor affects communication content in the ensuing voting stage (in the relevant treatments). Overall, we find evidence consistent with a "first message" premium in all treatments and for voters and proposers alike. To our knowledge, no other study reports on these important dynamics of communication.

Our analysis of communication content and structure reveals a number of new insights into bargaining processes and dynamics. We find that voters are the most active communicators, and that both they and proposers tend to receive superior bargaining outcomes where they initiate communication in a group – indicating, as noted above, a possible first-mover communication advantage. In contrast, the number of messages sent and received is negatively correlated with

beneficial bargaining outcomes. We also observe that voters are especially likely to communicate with each other – in particular, about future coalitions – at the voting stage when it is the only stage at which subjects are allowed to communicate. Finally, we observe that subjects choose to communicate different topics in different mediums and depending on whether they are a proposer or voter, and that communication content is strongly correlated with bargaining outcomes.

The article proceeds 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 the 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 (2022) for a meta-analysis and Agranov (2022) 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.

	No Communication	Communication
Proposer share as % of Equilibrium:		
Agranov and Tergiman (2014)	64.71	84.71
Baranski and Kagel (2015)	72.5	88
Minimum Winning Coalitions (%):		
Agranov and Tergiman (2014)	78	90
Baranski and Kagel (2015)	81.2	97.1

The data from the communication treatment from Baranski and Kagel (2015) is for games 6-10 from the treatment with open door communication (see Table A1), which closely resembles the experimental design in this paper and is comparable to Agranov and Tergiman (2014). The data from Agranov and Tergiman (2014) is for approved proposals that passed without delay in games 11-15.

Table 1: **Communication in Previous Bargaining Experiments**

Allowing subjects to communicate via chat screens during the proposal stage increases the

proposer's 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 (see Table 1). Both studies find that competition between voters for a spot in the winning coalition creates competitive pressures which drive their demanded 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 (2023)).

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, or 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 with costless communication.[6] 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 to be 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 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

[6]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); for communication with asymmetric disagreement values see Merkel and Vanberg (2020).

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 (Bradfield and Kagel, 2015; Cooper and Kagel, 2005; Cox and Stoddard, 2018; Cooper and Kagel, 2021; Arad et al., 2021).

Finally, our work is related to the growing literature on the study of bargaining processes. By process, we mean the sequence of moves (offers and counteroffers) that lead to an outcome (division of the benefits). 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.[7] Player identifiers are stable within a group, thus in case of a rejection, players are identifiable 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). Subjects' roles are assigned before communication can begin. Prior to a proposal being made, 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 – that is, once a proposal has been made but prior to voters casting their votes on that proposal (*P&V-Chat*, hereafter). Finally, we consider a treatment in which we allow for communication only at the voting stage (*V-Chat*, hereafter).

Once subjects are assigned their roles (i.e. proposer or voter)

[7] We have no discounting in our game, which in theory should affect the proposer's share. However, the meta-analysis by Baranski and Morton (2022) shows that discounting has no effect on the proposer's share (see Tables 2 and 3 of their paper). Importantly, as the cost of delay increases, there are fewer rejections. Thus, our parameter choices can be thought to mildly increase the likelihood of observing bargaining beyond the first round and our ability to investigate retaliation.

Subjects played a total of 15 *games* (or periods) with random re-matching. Subjects in a *game* may play multiple *rounds* in case rejections occur. Two games were randomly selected for payment on top of an $8 show-up fee. Sessions were conducted at the CESS experimental laboratory at New York University. Table 2 contains the details of our sample. In total, 273 subjects participated in the experiment.[8]

	Communication stage:		Total number of:				
Treatment	Proposal	Voting	Sessions	Subjects	Games	Rounds	Votes
No-Chat	No	No	3	51	255	349	698
P-Chat	Yes	No	4	57	285	366	732
P&V-Chat	Yes	Yes	6	93	416	493	986
V-Chat	No	Yes	4	72	340	452	904

Table 2: **Experimental Treatments, Sessions, Participants, and Number of Observations**

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 typically been assumed that players use stationary strategies, meaning that they employ identical strategies in identical subgames. This implies that proposals in each round within a game are independent of the history of play, and that voting strategies are a function of the current proposal only.

A unique payoff distribution arises under the symmetric stationary subgame perfect equilibrium (SSPE): the proposer keeps $20 and offers $10 to any voter at random.[9] Voters accept any share greater than or equal to $10 and approval occurs without delay.

Note that, theoretically under the SSPE, the possibility to communicate cannot affect equilibrium because only messages that are in line with the equilibrium predictions are credible. Moreover, this game is modelled as a setting 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

[8] We had a software malfunction in two sessions that resulted in collecting less than the 15 periods of play in *P&V-Chat* and *V-Chat*.

[9] The share offered to included 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).

$10 would not affect equilibrium play, because their threats are not credible.

However, existing experimental evidence shows that communication affects bargaining outcomes. Proposer power is closer to the SSPE prediction under treatments akin to *P-Chat* compared to *No-Chat* (Agranov and Tergiman, 2014; Baranski 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 who 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. Furthermore, in our *V-Chat* treatment, proposers will not be able to identify voters' desired shares prior to making an offer in the first round, which may lead to more restrained proposer demands.

Based on the preceding arguments, we state our first behavioral hypothesis as follows:

Hypothesis 1. *The proposer's share is lowest in No-Chat and V-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 reduce 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. In a similar vein, we expect the previous effect to be more pronounced in *V-Chat*.

Hypothesis 2. *Controlling for the offered share and proposer's demanded share, the probability of voting in favor is lowest in No-Chat and V-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 to a previous voter.

The meta-analysis by Baranski and Morton (2022) 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 will increase retaliatory behavior, especially where chat is allowed at the voting stage (*V-Chat* and *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 and V-Chat than P-Chat.*

5 Experimental Results

We start by summarizing the main bargaining outcomes, which are the overall distribution of the \$30 (i.e. two- or three-way splits), the proposer's mean share, and the round of agreement. Next, we will turn to the determinants of voting behavior and the effect of communication. Finally, we will 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 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.[10] In our regressions, each bargaining group in a given period of play is treated as an independent observation and we cluster standard errors at the subject and session levels. The

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

p-values presented in text for hypothesis testing of treatment differences correspond to a Wald test based on our econometric regressions, unless otherwise specified.

5.1 Main Outcomes

In Table 3 we summarize the main outcomes and in Table 4 we present econometric regressions for each outcome of interest with the treatments as independent categorical variables.

Regarding the overall distribution of the \$30, two-way splits are the modal proposal format, representing above 70% of all agreements. We find no significant effect of communication treatments relative to the *No-Chat* treatment. However, the timing of communication has a significant impact in the prevalence of two-way splits, which is lower in *V-Chat* compared to *P-Chat* (57.9% vs 75.4%, p=0.017).

		Is Communication Possible?			
	Equilibrium Benchmark[1]	Not Possible *(No-Chat)*	Proposal Only *(P-Chat)*	Proposal & Voting *(P&V-Chat)*	Voting Only *(V-Chat)*
Type of Proposal:					
2-way Splits	100%	71.9	75.4	72.1	57.9
3-way Splits	0%	28.1	24.6	27.9	42.1
Proposer's Share:					
Overall	\$20	14.6	15.4	14.8	13.2
Within 2-way splits	\$20	15.8	16.7	16.4	14.9
Round of Approval:					
Round 1	100%	75.1	79.0	84.6	74.1
Round 2	0%	17.8	15.1	12.5	20.3
Equilibrium Play[2]:					
Strict De nition		2.8	13.7	11.3	0.6
Weak De nition		9.5	35.8	20.9	1.5

[1] The equilibrium concept is the Stationary Subgame Perfect Equilibrium.
[2] An agreement is counted as a *Strict* SSPE play if the proposer's share is \$20 and the included voter's share is \$10. A *weak* SSPE is when the shares are within \$2 (inclusive) of the strict definition.

Table 3: **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) but the difference is not

significant at the 5% level or lower (p=0.064).[11] 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. However, allowing for communication only at the voting stage reduces the proposer's share compared to *No-Chat* by 9.6% (or \$1.4, p=0.001). Proposer power in *V-Chat* is also lower compared to *P-Chat* and *P&V-Chat* (p <0.001 and p=0.009).

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 3, we offer two measures of equilibrium play, a *strict* measure and a *weak* measure in which the proposer and included voter are within \$2 of the strict SSPE. Absent communication, we find that only 2.8% of agreements are SSPE. When communication is allowed at the proposal stage, we find a significant increase in the prevalence of SSPE splits (p <0.001 for *P-Chat* and p=0.044 for *P&V-Chat*). There is no difference between treatments that allow for communication at the proposal stage (p=0.703). Equilibrium outcomes are least likely in *V-Chat*, representing only 0.6% of all agreements. Our qualitative results hold if we allow for wiggle room under the weak SSPE measure. In this case, *V-Chat* results in significantly lower SSPE play compared to *No-Chat* (p=0.007).

The overwhelming majority of groups reach an agreement in the first round of bargaining. Consistent with previous findings, communication at the proposal stage aids mildly in fostering round-one agreements, though the effect is not statistically distinguishable from zero. Moreover, there are no differences between treatments with communication (see Panel E in Table 5).

Conclusion 1. *Communication has a differentiated causal effect on outcomes depending on when in the bargaining process it takes place. Allowing for communication only at the voting stage significantly reduces the proposer's share and results in a lower prevalence of equilibrium play. The opposite pattern arises when communication is allowed at the proposal stage only. Allowing for communication at both stages results in a middle ground between both timings and outcomes are often indistinguishable from the no communication treatment.*

Thus, we find evidence supporting Hypothesis 1 regarding the effect of the timing of communication. However, we must emphasize that we are unable to replicate the findings from previous

[11] With experience (games 6-15), the difference becomes significant, p=0.034.

	Dependent Variable:				
	Two-way Split	Proposer's Share	Delay	SSPE Strict	SSPE Weak
P-Chat	0.035	0.803	-0.038	0.109***	0.263***
	(0.078)	(0.391)	(0.044)	(0.022)	(0.070)
P&V-Chat	0.002	0.237	-0.095	0.085*	0.114
	(0.078)	(0.562)	(0.054)	(0.042)	(0.069)
V-Chat	-0.140	-1.391**	0.010	-0.022	-0.080**
	(0.074)	(0.354)	(0.038)	(0.012)	(0.030)
Constant		14.597***			
		(0.268)			
N	1294	1294	1294	1294	1294
R^2		0.056			
pseudo-R^2	0.017		0.011	0.102	0.140
Estimation	Probit	OLS	Probit	Probit	Probit

The No-Chat treatment is the base level.

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

Table 4: **Regressions of Bargaining Outcomes, Marginal Effects**

experiments with respect to the difference in the proposer's share between *P-Chat* and *No-Chat,* as we find a smaller treatment effect.[12]

5.1.1 Voting Behavior

We now turn to investigate whether or not communication and its timing affect voting behavior (Hypothesis 2). Specifically, we test for treatment differences in voting patterns controlling for the offered share, the proposer's demanded share, and treatment interactions with both shares. We estimate probit regressions and report marginal effects in Table 6.

Our regressions confirm a well-established result that the likelihood of voting in favor of a proposal correlates positively with one's own share and negatively with the proposer's demanded share. Allowing for communication at the proposal stage increases the likelihood of acceptance by 10.2 and 12.1 percentage points on average in *P-Chat* and *P&V-Chat*, respectively, with no statistically distinguishable difference between the two (p=0.664). However, communication at the voting stage only has no effect relative to *No-Chat* (p=0.356).

[12]One could further investigate the role of communication in *P-Chat* by pooling data from all past experiments to serve as the baseline and pooling the *P-Chat* data from Agranov and Tergiman (2014); Baranski and Kagel (2015) together with our data.

A. Tests for Minimum Winning Coalitions.			
	P-Chat	P&V-Chat	V-Chat
No-Chat	0.655	0.982	0.057
P-Chat		0.670	0.017*
P&V-Chat			0.053
B. Tests for the Proposer's Share.			
	P-Chat	P&V-Chat	V-Chat
No-Chat	0.057	0.679	0.001***
P-Chat		0.336	<0.001***
P&V-Chat			0.009**
C. Tests for the prevalence of SSPE (strict).			
	P-Chat	P&V-Chat	V-Chat
No-Chat	<0.001***	0.044*	0.069
P-Chat		0.752	<0.001***
P&V-Chat			0.009**
D. Tests for the prevalence of SSPE (weak).			
	P-Chat	P&V-Chat	V-Chat
No-Chat	<0.001***	0.100	0.007**
P-Chat		0.095	<0.001***
P&V-Chat			0.021*
E. Tests for agreement Delay.			
	P-Chat	P&V-Chat	V-Chat
No-Chat	0.386	0.076	0.797
P-Chat		0.405	0.395
P&V-Chat			0.102

The p-values correspond to tests of equality of the marginal effects obtained from the regressions in Table 4. * p<0.05, ** p<0.01, *** p<0.001.

Table 5: **P-Values for Wald Tests of Treatment Differences in Bargaining Outcomes**

	(1) No-Chat	(2) P-Chat	(3) P&V-Chat	(4) V-Chat	(5) Pooled
Own Share (in $)	0.046***	0.042***	0.038***	0.043***	0.042***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.001)
Proposer's Share (in $)	-0.019***	-0.012***	-0.015**	-0.034***	-0.020***
	(0.004)	(0.003)	(0.005)	(0.006)	(0.002)
P-Chat					0.102**
					(0.036)
P&V-Chat					0.121***
					(0.036)
V-Chat					-0.017
					(0.018)
N	698	732	986	904	3320
pseudo-R^2	0.527	0.469	0.510	0.434	0.487

The No-Chat treatment is the base level in column 5.

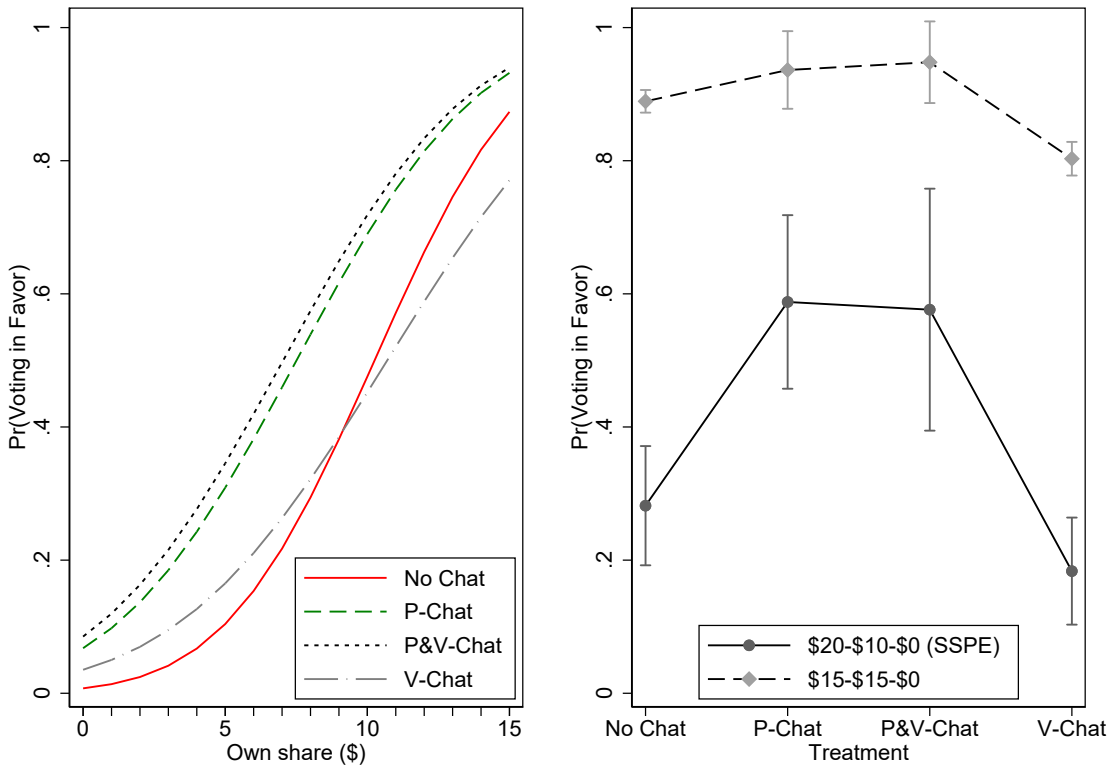
Robust standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001

Table 6: **Probit Regression, Marginal Effects for Voting**

While the aforementioned treatment differences already highlight the role of communication timing, it is crucial to investigate if differences in willingness to vote in favor remain for low and high offered shares. To this end, we plot the predictive margins of our probit regressions in Figure 1, by treatment, for each share between $0 and $15 (left panel). Two noteworthy patterns emerge. First, for high offered shares ($15), there is no difference in probability of acceptance between *No-Chat* and treatments with communication at the proposal stage, but subjects are still less likely to vote in favor compared to *V-Chat*.

Second, there are no differences in the odds of acceptance between *No-Chat* and *V-Chat* for shares between $7 and $11, but subjects in *V-Chat* are more likely to accept shares below $7, and less likely to accept shares above $11, compared to *No-Chat*. This suggests that subjects in *V-Chat* display higher aversion to inequality, which is consistent with the higher proportion of three-way splits in that treatment.

In which treatment are subjects more likely to vote in favor of the equilibrium proposal ($20-$10-$0)? As shown in Figure 1 (right panel), voters receiving a $10 share are most (and equally) likely to vote in favor in *P-* and *P&V-Chat*, and least likely in *V-Chat*. The equal split within a MWC ($15-$15) is equally likely to be voted in favor of in all treatments except *V-Chat*.



Notes: These graphs show the predictive margins of the probability of voting in favor. In the left panel, we graph the probability of voting in favor of different shares offered. For 95% confidence intervals, which are omitted here for clarity, see Online Appendix. The right panel graphs the likelihood that the voter receiving a positive share votes in favor, 95% confidence intervals are included.

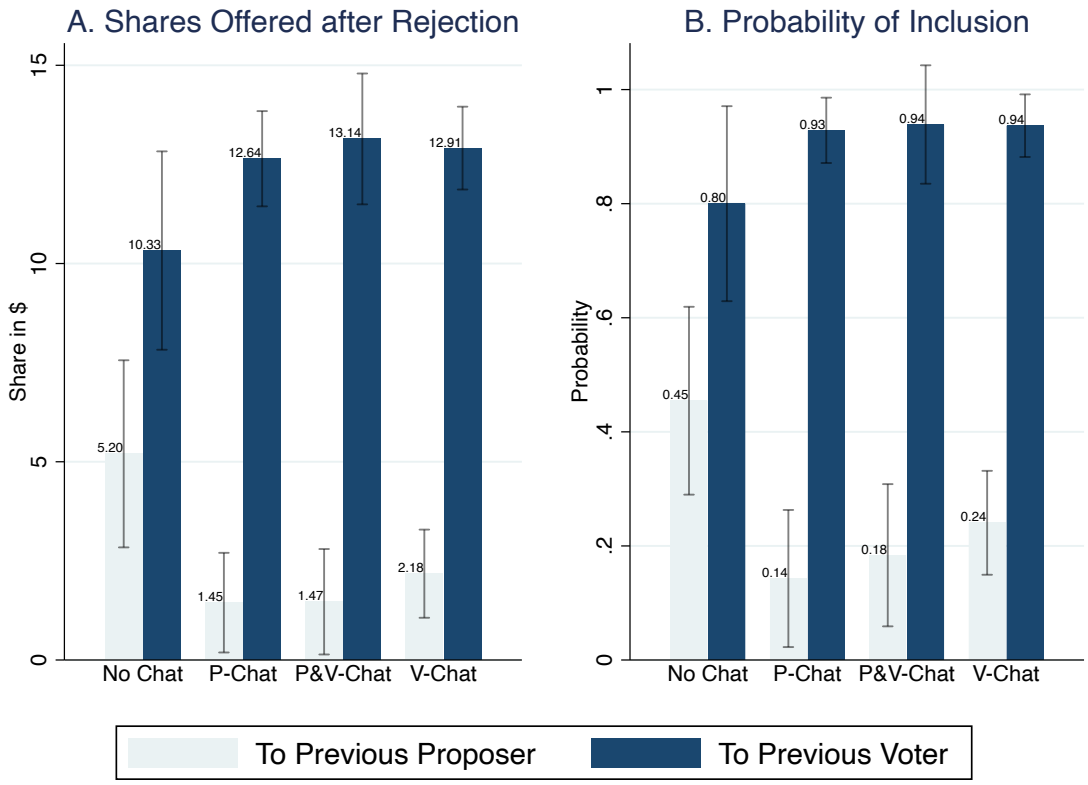
Figure 1: **Probability of Voting in Favor**

Conclusion 2. *Communication has a differentiated causal effect on voting behavior depending on its timing. When subjects can communicate at the proposal stage, they are (unconditionally) more likely to vote in favor compared to when they can communicate at the voting stage only and when they cannot communicate. The gap in likelihood of voting in favor fades between treatments with communication at the proposal stage and without communication as the offered share increases, but the same is not true for when communication is allowed at the voting stage only.*

Thus, we find partial support for Hypothesis 2 in that communication at the proposal stage leads to enhanced willingness to vote in favor but adding communication at the voting stage has no effect.

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.



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 who 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 with clustering at the session level.

Figure 2: **Shares Offered following Rejection, by Recipient Role in Previous Round**

To investigate whether subjects abide by stationary strategies we check if there are differences between the shares that are offered to failed proposers and previous voters. As shown in Figure 2, the mean share offered in the current round t to the subject that proposed in round $t-1$ 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 7). 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 2).

	(1) No-Chat	(2) P-Chat	(3) P&V-Chat	(4) V-Chat	(5) Pooled
To Previous Proposer (=1 if yes)	-5.127	-11.196**	-11.673**	-10.734**	-5.127*
	(2.717)	(1.287)	(1.511)	(1.105)	(2.298)
Constant	10.327*	12.643***	13.143***	12.911***	10.327***
	(1.398)	(0.633)	(0.843)	(0.550)	(1.182)
P-Chat					2.316
					(1.312)
P&V-Chat					2.816
					(1.416)
V-Chat					2.584
					(1.281)
To Previous Proposer × P-Chat					-6.069*
					(2.572)
To Previous Proposer × P&V-Chat					-6.546*
					(2.690)
To Previous Proposer × V-Chat					-5.607*
					(2.503)
N	110	112	98	158	478
F-stat	3.561	75.626	59.687	94.315	71.553
R^2	0.160	0.665	0.731	0.616	0.558

The No-Chat treatment is the base level in column 5.

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

Table 7: **Linear Regression of Share Offered in Rounds following a Previous Rejection**

Conclusion 3. *Subject behavior following a disagreement is history-dependent and therefore does not resemble stationary strategies, with and without communication. Specifically, failed proposers are offered lower shares compared to previous non-proposing members, which leads to a gap in the empirical continuation value of the game. The effect is stronger in treatments with communication.*

Thus, we find support for Hypothesis 3, in that communication leads to an increase in the likelihood and scope of retaliation.

	(1) No-Chat	(2) P-Chat	(3) P&V-Chat	(4) V-Chat	(5) Pooled
To Previous Proposer (=1 if yes)	-0.345	-0.786***	-0.755***	-0.696***	-0.649***
	(0.186)	(0.091)	(0.114)	(0.071)	(0.051)
P-Chat					-0.092***
					(0.018)
P&V-Chat					-0.066***
					(0.012)
V-Chat					-0.039*
					(0.016)
N	110	112	98	158	478
pseudo-R^2	0.099	0.517	0.484	0.419	0.386

The No-Chat treatment is the base level in column 5. Robust standard errors in parentheses. * p<0.05, ** p<0.01, *** p<0.001

[1] A subject is considered to be included in the proposal if her share is greater than \$0.

Table 8: **Probit for Inclusion in the Proposal, Marginal Effects**

6 Communication Content and Structure

Our findings reported thus far indicate that communication, and its timing, carries implications for bargaining outcomes. However, we have only been able to speculate as to whether communication operates through theorized mechanisms or via alternative channels. Without a deeper consideration of *what* and *how* people communicate, we are unable to pinpoint precisely *why* communication matters.

In this Section, we aim to shed additional light into the mechanisms through which communication affects bargaining outcomes. We evaluate communication on two different dimensions. First, we consider communication content, or what people say. Second, we investigate communication structure, which we operationalize as the order (who speaks first in a given group) and volume (total number of messages sent and received) of communication. Both for content and structure, we explore how patterns vary with a subject's role (voter or proposer), the stage of communication (voting or proposal) and randomly assigned treatment (*P-Chat*, *P&V-Chat*, or *V-Chat*), and the medium of communication (private between a proposer and voter or between two voters, or public). Finally, we consider how content and structure relate to observed bargaining behavior.

6.1 Communication Content

In order to evaluate communication content, we tasked three coders with classifying subjects' messages into one of nine possible categories (see Table 9).[13] Categories were chosen such that they reflected discussions, captured theoretical concepts of interest, and matched our measures of bargaining behavior. Each coder classified the full corpus of conversations in treatments with communication, and in our main analysis, we only consider a message as belonging to a given category if at least two of three coders counted it as such. The coding exercise was conducted for each possible chat box within the game; thus, we observe from and to whom a message was sent, as well as the stage – for some categories – at which it occurred. Appendix A provides additional details about the coding process and validation.

6.1.1 Content by Medium, Role, Stage, and Treatment

Figure 3 displays frequencies of the different categories of communication observed in each possible medium of communication: between a proposer and voter in private, between two voters in private, and between all members of the group.[14]

Communication Medium Results indicate that subjects choose between mediums strategically, with content seemingly most benefiting proposers in private communication between proposers and voters; least benefiting proposers in private communication between voters only; and falling somewhere in between in public communication between all three partners. We find that content concerning MWCs and competition are substantially more likely to occur, and three-way splits less likely, in private between a voter and a proposer as compared with in public between all three players. We also find that attempts to persuade partners to vote in favor of a proposal occur most often in private between a proposer and voter, whereas attempts to persuade partners to vote against a proposal occur most often in private between voters. Discussions to punish a previous round's proposer occur relatively rarely across mediums, but there is some suggestive evidence that they appear more often in private as opposed to public channels.[15] We also see that future coalitions

[13] Our procedures are close to those employed by Cason et al. (2012) and Baranski and Kagel (2015), with the central difference being that we hired three – instead of two – coders.

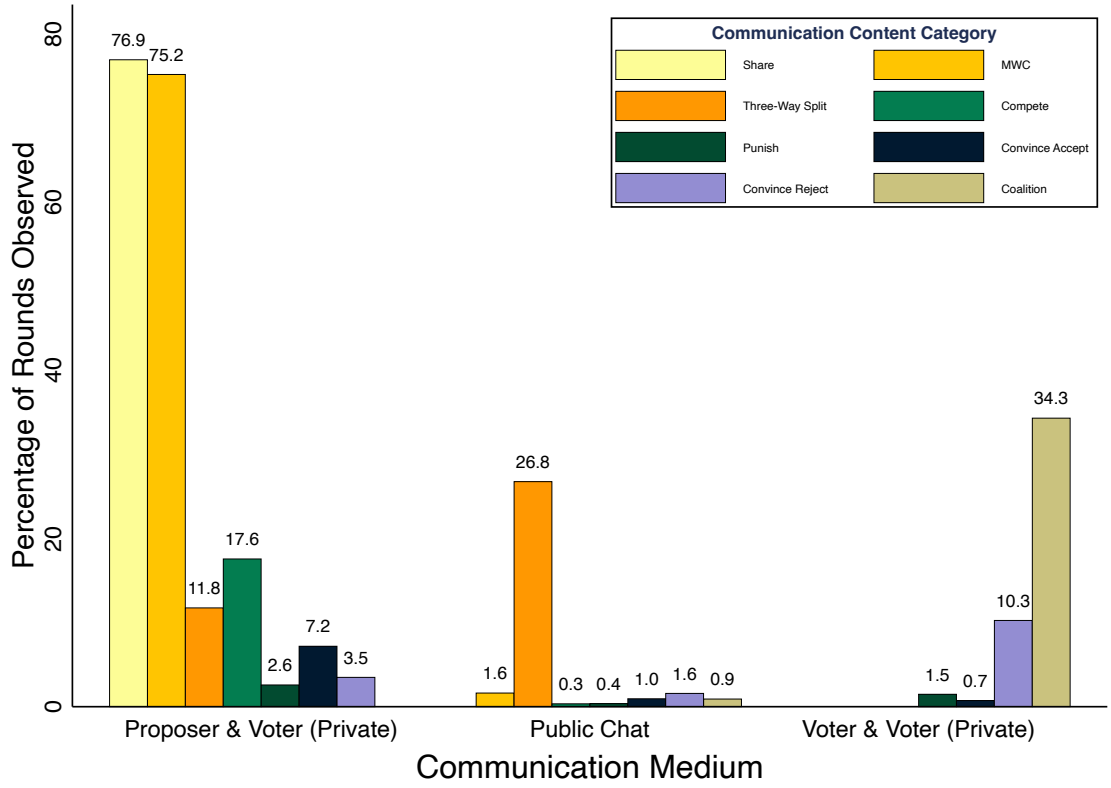
[14] Recall from Table 9 that not all categories were coded for all mediums or stages.

[15] Note also that this category is only coded for rounds beyond the first, as it concerns discussions about a previous round's proposer.

Category	Coded as Having Occurred Whenever:	Example(s)	Stage(s)	Medium
Three-way split	Member states all three members should receive non-zero share of fund.	"I will give everyone something"	Proposal	Proposer-Voter, Public
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"	Proposal	Proposer-Voter, Public
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"	Proposal	Proposer-Voter, Public
Desired Share	Member states how much they will accept.	"Give me 50%"	Proposal	Proposer-Voter
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"	All	Public, Voter-Voter
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"	All	All
Convince to reject	Member seeks to convince another member to vote against a proposal.	"No way you should accept an offer that small"	Voting	All
Convince to accept	Member seeks to convince another member to vote in favor of a proposal.	"You should vote in favor, you won't get better"	Voting	All
Irrelevant	All the messages are unrelated to the task.	Only greetings are exchanged.	N/A	N/A

Notes: Possible stages are proposal only, voting only, or both proposal and voting (all); possible mediums are proposer-voter private, public, or voter-voter private.

Table 9: **Communication Categories and Coding**



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. Desired share, MWC, three-way split, and compete categories were not coded for the voter and voter communication medium; coalitions were not coded for the proposer and voter medium; and desired share was not coded for the public chat medium (see Table 9 and Appendix A). We pool across *P-Chat*, *P&V-Chat*, and *V-Chat* treatments.

Figure 3: **Communication Content by Medium**

are most often discussed in private between voters, as compared with in public. Appendix Table C1 shows that these differences, with the exception of punishment, are statistically distinguishable from zero when controlling for treatment assignment and clustering at the session and subject levels.[16] Finally, we observe that while subjects tend to choose strategically to which medium they should send which messages, we find little evidence that subjects send conflicting messages in private and public in a given round (see Appendix Figures C4-C6).

Conclusion 4. *Subjects choose where to communicate strategically, with content likely to increase proposer power most often observed in private channels between proposers and voters; content focused on voter coordination most common in private channels between voters; and calls for three-way*

[16]These results are in line with Agranov and Tergiman (2019) in that that private communication channels are mainly used to lobby for one's benefit (and largely utilized in majoritarian bargaining), while public channels serve to promote equality (and are mainly utilized under unanimity).

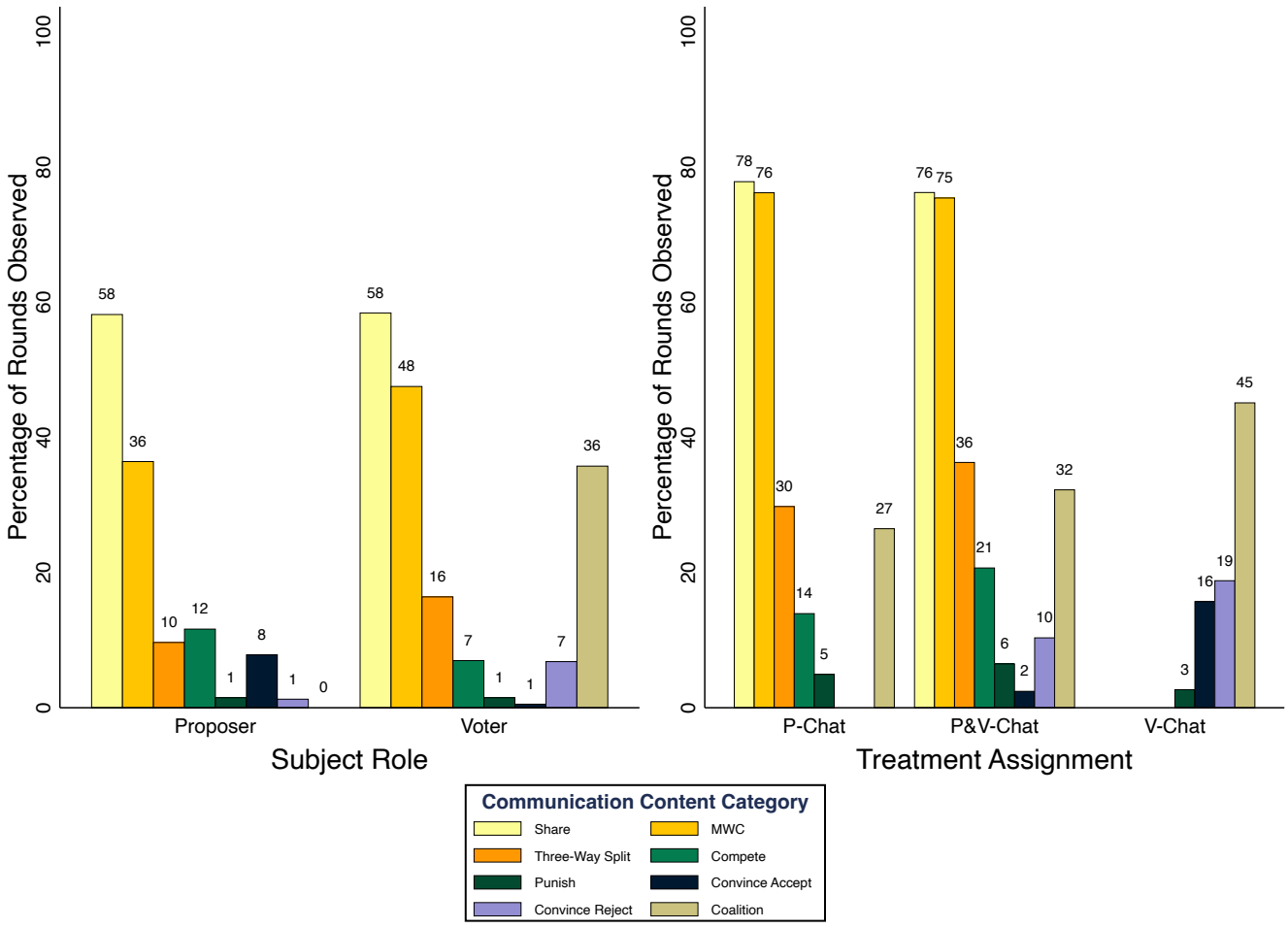
splits most often found in public channels.

Subject Role Were proposers more or less likely than voters to communicate certain topics? Did content differ across our communication (*P-Chat*, *P&V-Chat*, and *V-Chat*) treatments? Figure 4 displays communication content category frequencies, split by a subject's randomly assigned role (proposer or voter, left panel) and treatment assignment (*P-Chat*, *P&V-Chat*, or *V-Chat*, right panel). Beginning with subject role, we find that voters are substantially more likely than proposers to discuss future coalitions, as well as marginally more likely to discuss both MWCs and three-way splits. As expected, proposers use the chat at the voting stage to attempt to convince voters to accept their proposal, while voters use it to convince their partners to reject it.[17] Similar percentages of proposers and voters discuss their desired shares, and few of either role discuss punishing the previous round's proposer. Communication content thus largely varies with subject role as one might expect, with voters and proposers initiating discussions to serve their interests. While voters discussing MWCs more often than proposers might appear to run contrary to this pattern, it could reflect voters preempting anticipated competition and seeking to ensure their inclusion in a winning coalition.

Conclusion 5. *Voters are more likely than proposers to discuss MWCs, three-way splits, and future coalitions, and are less (more) likely to persuade voters to vote in favor (against) a proposed division.*

Treatment and Stage Turning to an analysis of communication content by treatment assignment, we find additional support for the notion that communication has a differentiated effect depending on its timing. Differences are particularly pronounced where participants were only permitted to communicate at the voting stage. First, consistent with Conclusion 1 that allowing communication only at the voting stage reduces the proposer's share and the prevalence of equilibrium play, we find that voters in this treatment are substantially more likely to discuss forming future coalitions (in 45% of rounds) than are voters who are allowed to communicate at the proposal stage only (27%) or at both voting and proposal stages (32%). That voters in the *P&V* treatment are less likely to discuss coalitions than in the *V-Chat* treatment is particularly striking given that

[17] Reported differences by subject role are statistically distinguishable from zero, see Appendix Table C1.



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 content category (see Table 9). The right panel compares communication type percentages across our three treatments with communication: *P-Chat*, *P&V-Chat*, and *V-Chat* (recall that not all categories were coded for all stages and thus treatments).

Figure 4: **Communication Content by Subject Role and Treatment**

a participant in the *P&V* treatment was coded as having discussed a coalition if they discussed a coalition in *either* the proposal *or* voting stage. Further, we find that this difference is particularly driven by changing communication patterns at the *voting* stage: if we break down coalition discussion frequency by stage in our *P&V* treatment where communication was allowed at both stages, we find that while the frequency at the proposal stage (27%) mirrors the frequency in the *P-Chat* treatment (also 27%), the frequency with which coalitions are discussed at the voting stage (13%)

is substantially lower than in our *V-Chat* treatment (45%).[18,19] It thus appears that subjects are particularly likely to discuss coalitions when they are only allowed to engage in communication in the voting stage.

Second, potentially consistent with Conclusion 2 that subjects are less likely to vote in favor of proposals when communication is only allowed at the voting stage, we observe not only more frequent efforts at future coalition formation, but also at persuasion in our *V-Chat* treatment as compared with our *P&V-Chat* treatment. As Appendix Tables C1 and C2, respectively, show, differences in persuasion and future coalition discussion frequencies are statistically distinguishable from zero.

Third, we find only substantively small and, generally, statistically indistinguishable differences in communication content patterns across *P-Chat* and *P&V-Chat* treatments. Subjects are similarly likely in these treatments to discuss desired shares, MWCs, and punishing a previous round's proposer; while subjects in *P-Chat* are less likely to discuss three-way splits and to engage in competition, these differences are of small magnitude and are not statistically distinguishable from zero. However, as shown in Appendix Figure C1, 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 to request from their committee members. Specifically, proposers tend to state higher desired shares in the *P-Chat* treatment as compared with the *P&V-Chat* treatment, results that are consistent with theoretical prediction and Conclusion 1. In sum, while communication content differences are most pronounced when comparing the *P&V-Chat* treatment to the *V-Chat* treatment, we also see some evidence consistent with proposer power being mildly greater in the *P-Chat* treatment than in the *P&V-Chat* treatment.

Conclusion 6. *Voters are more likely to discuss future coalitions and engage in persuasion at the voting stage where they are only allowed to communicate at this stage (V-Chat), as compared with when they are allowed to communicate at both proposal and voting stages (P&V-Chat). Differences at the proposal stage across P-Chat and P&V-Chat are generally small, though we observe that proposers demand higher shares when they are only allowed to communicate at the proposal stage.*

[18] The difference between coalition discussion at the voting stage by treatment (*P&V-Chat* and *V-Chat*) is statistically distinguishable from zero, see Appendix Table C2.

[19] A number of groups recorded communication at both the *proposal* and *voting* stages, which accounts for why the percentage ever discussing coalitions in the *P&V-Chat* treatment is less than the sum of the percentages discussing coalitions at the proposal and voting stages.

6.1.2 Communication Content and Bargaining Behavior

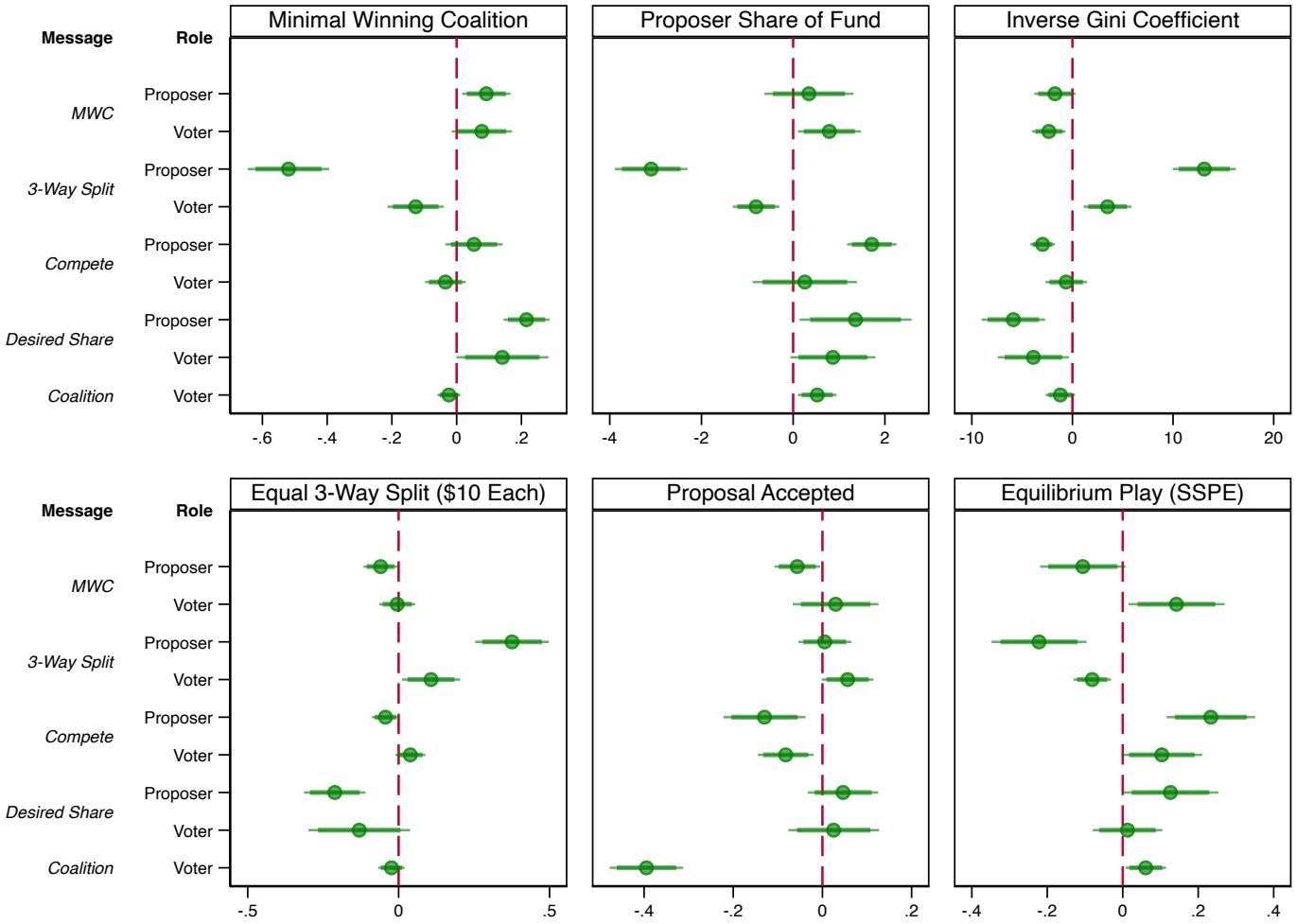
Does communication content correspond to observed bargaining behavior? To investigate this question, we can test whether, for instance, proposals are more likely to be three-way splits where a member of the bargaining group stated that all members should receive a non-zero share of the fund. Figure 5 presents results, clustering at the session and subject levels and controlling for treatment assignment.[20] 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 three-way divisions of the fund when group members discuss three-way splits; 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.[21] We also observe that proposers tend to form coalitions with voters who state smaller desired shares (see Appendix Figure C3), and that a large majority (over 80%) of voters vote in favor of a proposal where they are offered at least their stated desired share (see Appendix Figure C7). Given that communication content clustered around specific mediums (see Figure 3), it appears that content is associated with related bargaining outcomes across mediums. Effects are often stronger where proposers discuss topics, perhaps reflecting superior proposer power.

Consistent with Conclusion 3, we also observe support for the notion that communication can help to facilitate history-dependent behavior (see Section 5.1.2). Specifically, in Figure 6, we consider whether there are differences in the shares offered to a previous round's proposer and voters (as in Figure 2), based additionally on whether voters in that previous round discussed forming a future coalition or not.[22] Evidence is consistent with subjects using communication to facilitate retaliation, as we observe that failed proposers receive comparatively smaller shares of the fund in subsequent rounds – and are excluded comparatively more often from a coalition – where voters had

[20] In order to present results pooling across treatments, we exclude the *V-Chat* treatment, which only had two content categories in common with both of the other two treatments: future coalitions and punishment. We similarly do not include "convince to accept" and "convince to reject" categories, which were coded for the *P&V-Chat* but not the *P-Chat* treatment.

[21] We further observe a 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 C14).

[22] We present discussion of coalitions, as opposed to punishment, 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. Results regarding punishment are available upon request.



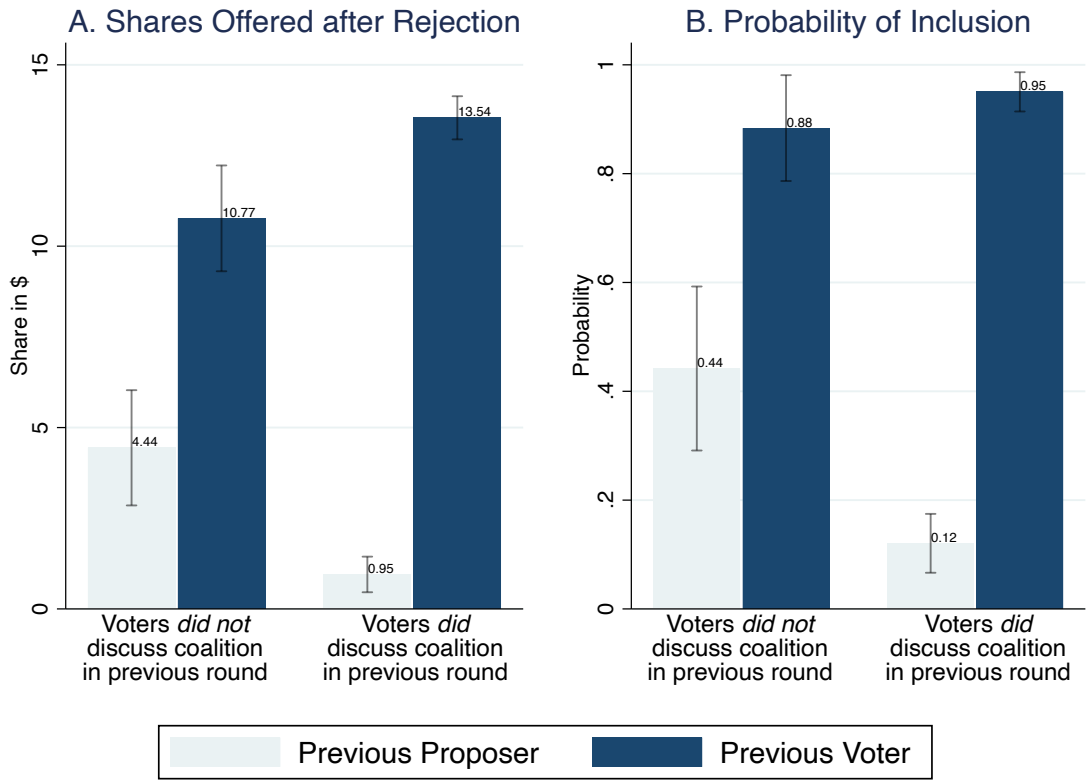
Notes: This figure displays the relationship between whether a category of communication content was coded by a majority of coders as having occurred, and bargaining outcomes (MWC, the proposer's share of the fund, equality as measured by a Gini coefficient and occurrence of three-way splits, whether a proposal was accepted, and whether there was a weak measure of 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 observed for voters. We cluster standard errors at the subject and session levels; communication content refers to the proposal stage only for all outcomes with the exception of future coalitions. 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.

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

discussed forming a coalition in that preceding round.[23] Further, mirroring evidence elsewhere of voter coordination being stronger where communication is allowed at the voting stage, we observe that previous discussions of coalitions most influence previous proposer shares and probability of coalition inclusion in subsequent rounds in treatments with communication at the voting stage as

[23] Results are statistically distinguishable from zero, see Appendix Table C3.

compared with the proposal stage only (see Appendix Figure C2).



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 who 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. We pool across all treatments with communication.

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

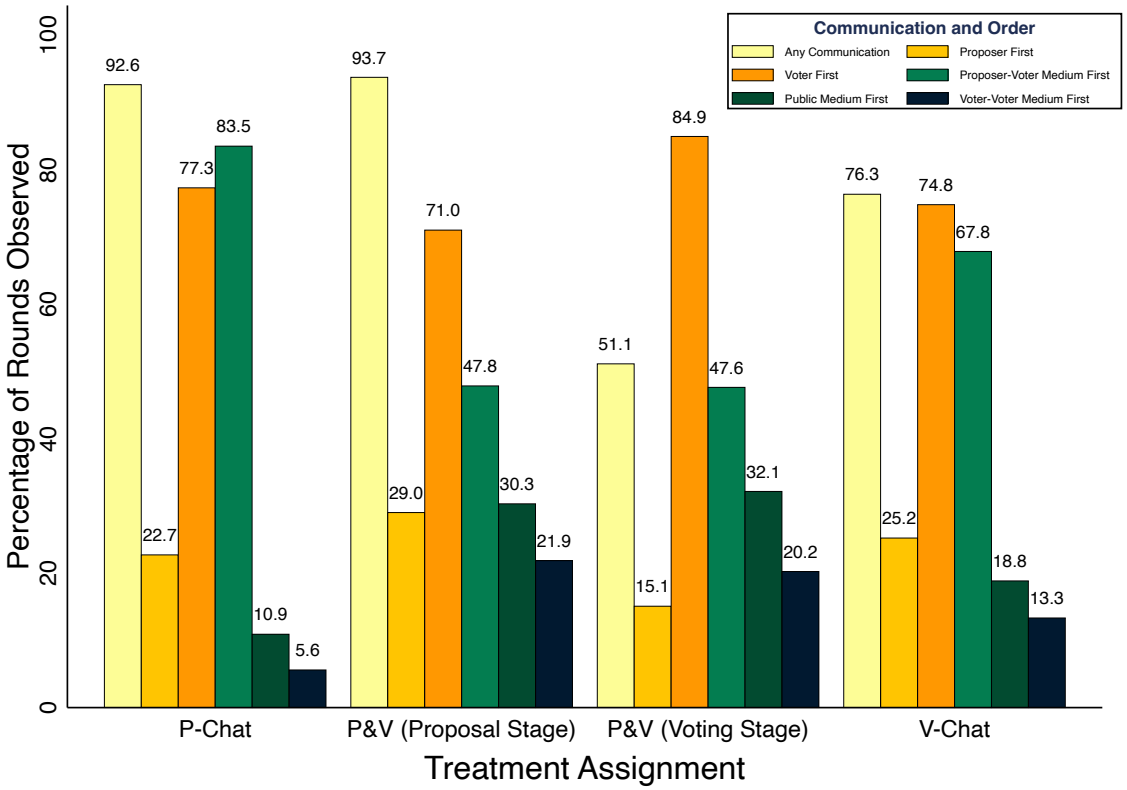
Finally, just as communication content may influence bargaining outcomes, the terms of a proposal might be thought to influence what is communicated and by whom. Consistently, we observe that voters are more likely to discuss forming coalitions where proposers demand a higher share for themselves (and offer less to voters), and more likely to attempt to persuade other voters to vote against a proposal where they are offered a smaller share (see Appendix Figures C8 and C9). The latter effect appears to be stronger in the voting stage in the *V-Chat* treatment as compared with the voting stage of the *P&V-Chat* Treatment, perhaps consistent with evidence presented earlier that voters are more active as regards persuasion and coalition formation when they are only permitted to communicate at the voting stage.

Conclusion 7. *Communication content is correlated with bargaining outcomes. Retaliatory history-dependent behavior as a function of communication content appears to be strongest in treatments where communication is allowed at the voting stage.*

6.2 Communication Structure: Order and Volume

Next, we turn to communication structure, operationalized as the order and volume of messages.

Communication Order and Volume: Patterns Figure 7 displays, by treatment assignment (*P-Chat*, *P&V-Chat*, and *V-Chat*) and stage (proposal or voting), overall communication rates as well as – conditional on there being communication in a given group in a given round – patterns in the order of communication (whether a group's first message was sent by a proposer or voter and whether it occurred in the private proposer-voter medium, the public medium, or the private voter-voter medium).



Notes: This figure displays, by treatment and stage, the percentage of rounds in which there was any communication between group members, as well as whether the first message came from a proposer or voter and occurred in the chat box between a proposer and voter in private, in the public chat box, or in the chat box between voters in private.

Figure 7: **Communication Order: Medium, Role, Stage, and Treatment**

A few observations are worth note. First, we observe that communication rates are highest at the proposal stage and lowest in the voting stage, perhaps reflecting that subjects anticipate greater gains from communication where they can still potentially affect the terms of a proposal. Second, this difference, while still present, is lesser when individuals are *only* allowed to communicate at the voting stage, as opposed to being allowed to communicate at both the proposal and voting stages. That is, we observe higher rates of communication at the voting stage in the *V-Chat* treatment than in the *P&V-Chat* treatment. Given that we do not observe similar differences in communication rates at the proposal stage when we compare the *P-Chat* to the *P&V-Chat* treatment, this difference is likely not solely attributable to whichever stage subjects are only allowed to communicate at mechanically becoming more salient. Instead, it may reflect subjects' comparatively greater need in the *V-Chat* treatment to express information relevant for voting that subjects in the *P&V-Chat* treatment have already shared in the proposal stage.

Third, turning to subject role, we observe that voters – across treatments and stages – are far more likely than are proposers to initiate communication in a group, consistent with evidence presented elsewhere that voters are particularly active communicators. Fourth, we find that while the initial message sent is most often in private between a proposer and voter, initial messages in the public medium and between voters in private occur comparatively more often in the *V-Chat* and especially the *P&V-Chat* treatment as compared with the *P-Chat* treatment.[24]

Turning to communication volume, Appendix Figures C10 and C11 display the average numbers of messages sent and received, respectively, by subject role and treatment assignment. Across treatments, we observe that voters send more messages on average and proposers receive more messages on average, again consistent with the notion firstly that voters are more proactive in their communication than are proposers and secondly, that proposers are the central focus of voters' attempts at communication.

Conclusion 8. *Voters are more active communicators, and tend to communicate first in a group more often, than proposers. Overall, subjects communicate most frequently at the proposal stage. However, subjects communicate comparatively more frequently at the voting stage when they are only permitted to communicate at this stage (V-Chat), as opposed to when they are allowed to communicate at both proposal and voting stages (P&V-Chat).*

[24]Reported differences are statistically distinguishable from zero (see Appendix Table C4).

Communication Order, Volume, and Bargaining Behavior Do communication order and volume carry consequences for bargaining outcomes? Figure 8 displays average accepted proposer and voter share by whether there was communication in a group and who (the proposer or a voter) initiated it. We observe that proposers receive a greater (lesser) portion of the pie where they (voters) initiate communication, and that they earn the least where there is no communication in a group. As shown by panel B, these patterns are reversed for voters, who earn more on average where they initiate communication.[25] Consistently, we observe that voters earn more on average – and proposers less – where the first message exchanged is in private between voters (see Appendix Figure C12). In sum, who initiates communication in a group appears to be related to bargaining outcomes and findings are consistent with a first-mover advantage.[26]

Whereas initiating communication appears to be related to positive bargaining outcomes for voters, we see no such relationship for the volume of messages exchanged. To the contrary, Figure 9 shows that the number of messages sent or received in a given round is inversely related to a voter's likelihood of voting in favor of a proposal, perhaps indicating that players communicate more where there is an unequal proposed division. Consistent with this interpretation, we find that proposers' shares, but not voters' shares, increase with the number of messages sent (see Appendix Figure C13). We do not find that effects vary meaningfully with treatment assignment.

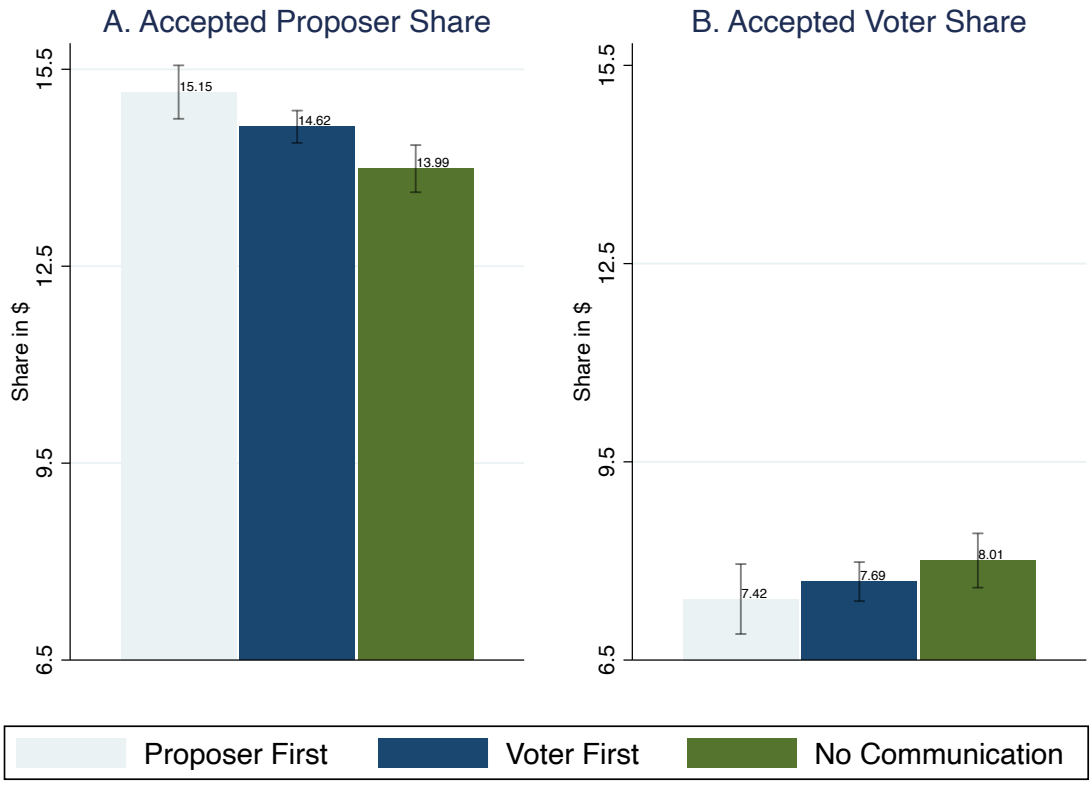
Conclusion 9. *Communication order results are consistent with a first-mover advantage, as improved bargaining outcomes are associated with initiating communication in a group. In contrast, a higher volume of messages sent or received is associated with worse bargaining outcomes.*

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 dynamics. We study a canonical model by Baron 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)

[25] Differences are statistically distinguishable from zero when controlling for treatment assignment and clustering standard errors (see Appendix Table C5).

[26] We do not observe much evidence of an interaction effect between treatment assignment (or stage of communication) and who initiates communication, though this could be attributable to insufficient sample size. Results are available upon request.

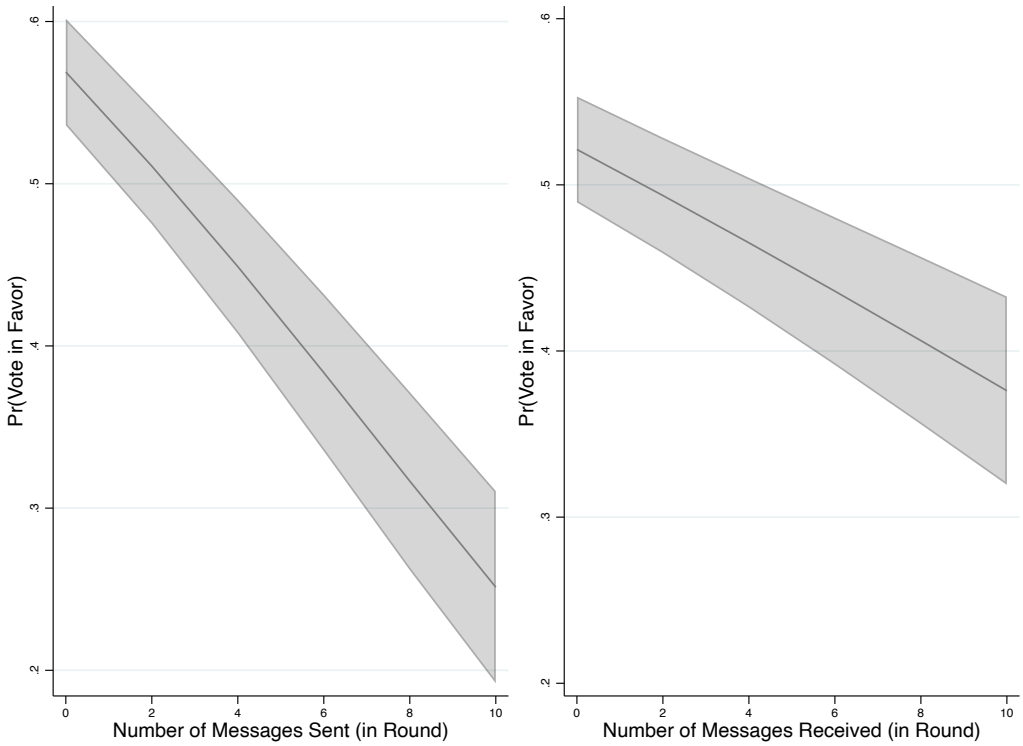


Notes: This figure displays the average accepted proposer (left panel) and voter (right panel) share by whether there was communication in a group and who (the proposer or a voter) initiated it. 95% confidence intervals included. We only include treatments where communication was possible.

Figure 8: **Proposer and Voter Accepted Share by Initiator**

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 when communication is introduced only at the voting stage proposer power falls below the levels observed absent communication. Voting patterns reveal that subjects evaluate offered shares differently depending on the timing of communication, with subjects being more likely to reject when communication is allowed at the voting stage only. This difference in behavior is inconsistent with the consequentialist premise according to which subjects should evaluate any monetary split in the same manner regardless of whether communication was allowed or when it happened. Instead, the evidence indicates that when subjects are able to verbally negotiate at the proposal-making stage they are more willing to vote in favor of any given share.[27]

[27] Our design is between subjects, thus we cannot directly observe violations, but a future experiment could test for treatment differences within subjects.



Notes: This figure displays the predicted probability that a voter votes in favor of a proposal based on the number of messages they sent (left panel) or received (right panel) in a given round. We control for the share offered and treatment assignment.

Figure 9: **Communication Volume and Voting Outcomes**

Our second finding concerns the effect of communication on the bargaining process. Theoretically, there should be no delay in reaching an agreement, but between 15% and 25% of groups do not agree in the first round of bargaining. How do subjects react to a disagreement and how do proposals evolve thereafter? 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 *a la* Baron and Ferejohn are scarce, which makes replication efforts quite important. While we quali-

tatively reproduce the central previous finding that proposer power is larger under communication taking place at the proposal stage only compared to no communication games, the magnitude of the effect is smaller in our sample. As shown in Table 1, the proposer's power is closer to the stationary equilibrium prediction with communication at the proposal stage in Agranov and Tergiman (2014) and Baranski and Kagel (2015). This certainly calls for more experiments in order to understand the factors that may drive subject- and sample-level differences in bargaining behavior, such as socio-demographic characteristics, cultural norms, and personality traits, among others.

Despite this difference with the previous experimental literature, we ask: Are there any robust patterns of behavior emerging in majoritarian bargaining experiments with communication? Four of our findings are shared with the closely-related investigations by Agranov and Tergiman (2014) and Baranski and Kagel (2015). First, communication at the proposal stage 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 *self* 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, when communication occurs at the proposal stage. 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., in press). 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. (2022). Legislative bargaining experiments. In Karagözoğlu, E. and Hyndman, K., editors, *Bargaining: Current Research and Future Directions*, pages 179–202. Springer.

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. A. (2023). Communication in multilateral bargaining with joint production. *Experimental Economics*, 26(1):55–77.

Baranski, A., Haas, N., and Morton, R. (in press). Pork versus policy: Experimental evidence on majoritarian bargaining with real-world consequences. *Journal of Politics*.

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. (2022). The determinants of multilateral bargaining: A comprehensive analysis of Baron and Ferejohn majoritarian bargaining experiments. *Experimental Economics*, 25(4):1079–1108.

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.

Cooper, D. J. and Kagel, J. H. (2021). Infinitely repeated prisoner dilemma games: Comparing teams with individuals. `https://sites.google.com/view/davidjcooper13/research?authuser=0`. Last accessed October 18, 2022.

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.

Eraslan, H. and Evdokimov, K. S. (2019). Legislative and multilateral bargaining. *Annual Review of Economics*, 11(1):443–472.

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.

Merkel, A. and Vanberg, C. (2020). Legislative bargaining with costly communication. *Public Choice*, 183(1):3–27.

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

We created the nine coding categories displayed in Table 9 with three aims in mind. First, we wanted our categories to accurately reflect individuals' discussions. Second, we 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.[28]

To increase the validity of our coding exercise, we hired three research assistants and had each code the entire corpus of conversations in the treatments with communication (*P-Chat*, *P&V-Chat*, and *V-Chat*) according to the categories in Table 9. 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.1). 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 our three coders.[29] As noted in the main text, in our analyses, we further only consider a message as belonging to a given category if at least two of three coders counted it as such.

[28] 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.

[29] An inter-rater agreement test for our *P&V-Chat* and *P-Chat* treatments 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.

A.1 Coding Instructions for P-Chat and P&V-Chat

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".

A.2 Coding Instructions for V-Chat

Chat Coding Instructions for Research Assistants

General Description of the Task

You will be reading over conversations between members of groups that were bargaining to divide a given amount of money among themselves. These group members were participants in an experiment that took place during the month of September 2022 at New York University, New York.

In each period of the experiment, subjects were randomly matched into groups of three and one group member was randomly selected to be the person to propose a division of the $30 among himself and the two other members.

Proposers had to choose a distribution of the fund, which the remaining members then voted on. If a majority of group members approved the proposal, then the proposal was binding, and the proposed division of the fund was implemented. If not, the process would repeat itself until approval was reached. Thus, the same group could potentially negotiate for several rounds.

Importantly, subjects were allowed to communicate with each other during the voting stage via chat screens for up to 3 minutes, only after a proposal had been made.

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 group's chats will be displayed across four windows (proposer-voter 1, proposer-voter 2, voter 1- voter 2, public), since each person could communicate privately with another member and publicly with all members.

Under each window, there will be several categories that you should mark in case they apply to the conversation in that window (often more than one category applies, you can check all that apply). The categories are:

1. **Convince to reject:** when a member seeks to convince another member to vote against the proposal or simply asks them to do so without offering arguments.
    a. **Reason:** In case this category is coded, there will be three options:
        i. **Selfish:** The subject claims she/he was not offered enough and/or she wanted more.
        ii. **Pro-social:** The subject claims that the offer is not fair for everyone, that some people are left out, etc.
        iii. **No reason:** when no reason is provided accompanying the suggestion to reject.
2. **Convince to accept:** when a member seeks to convince another member to accept the proposal or simply asks them to do so without offering arguments
    a. **Reason:** In case this category is coded, there will be three options:
        i. **Selfish:** The subject tells the other member that he/she was offered enough.
        ii. **Pro-social:** The voter claims that the offer is fair for everyone, that no one is left out, etc.
        iii. **No reason:** when no reason is provided accompanying the suggestion to accept.

3. **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, let’s reject and divide it between ourselves”, “next time around one of us will be in charge of splitting”. If one member proposes the idea and gets no response, only code the member who proposed the idea. If the member gets a positive response code both of them.
    a. **Type of coalition proposed:**
        i. **Minimum winning coalition:** money split between two only
        ii. **All-way split:** everyone receives a positive share
4. **Deal reached:** if subjects appeared to have agreed on a deal, if the conversation indicates they are both in agreement over coalescing in the future. The options are
    a. **Weak deal:** no specification of future agreements, only an intention to share the pie later.
    b. **Strong deal:** specifies the way in which the pie will be split
    c. **No deal:** no evidence of subjects agreeing for
5. **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 during bargaining rounds 2 or greater (when there has been a rejection).
    a. Important: if a member expresses the desire to punish the previous proposer, only code the member who proposed that course of action. If the responding member states support such as “yes that’s what I wanted to say” or provides additional justification, also code them as such.
6. **Irrelevant Messages:** We are interested in identifying bargaining rounds in which all messages were irrelevant in the sense that they do not refer to the game. Examples would be (1) only greetings (2) only humorous remarks or expressions of frustration, or other emotions (“this sucks” or “happy to be here!”).
    a. If a subject asks “what should we do?” this is not to be coded as irrelevant.
    b. Only mark this category if all messages are irrelevant.

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

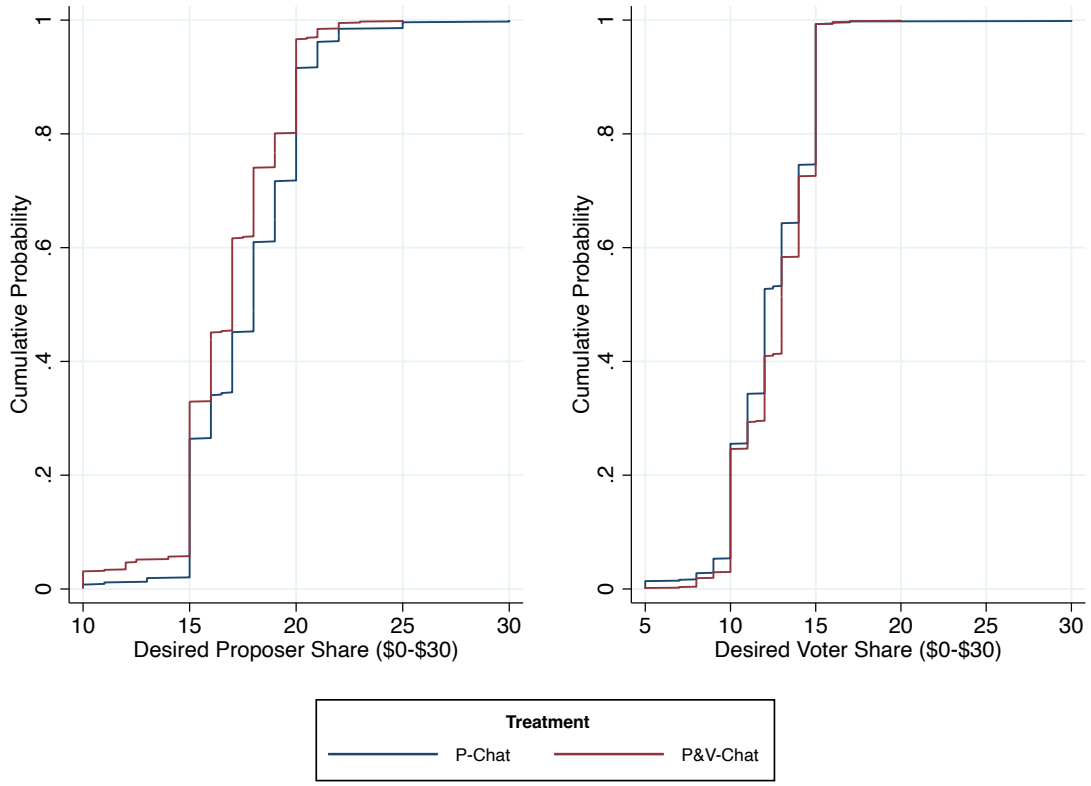
1. Everyone is randomly assigned into groups of 3
2. There are $30 to divide.
3. One of you will be randomly chosen as the proposer.
4. You will have up to three minutes to chat while the proposer enters a division of the money and up to three minutes to chat while a voting decision is reached.
5. Be 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

C.1 Additional Figures

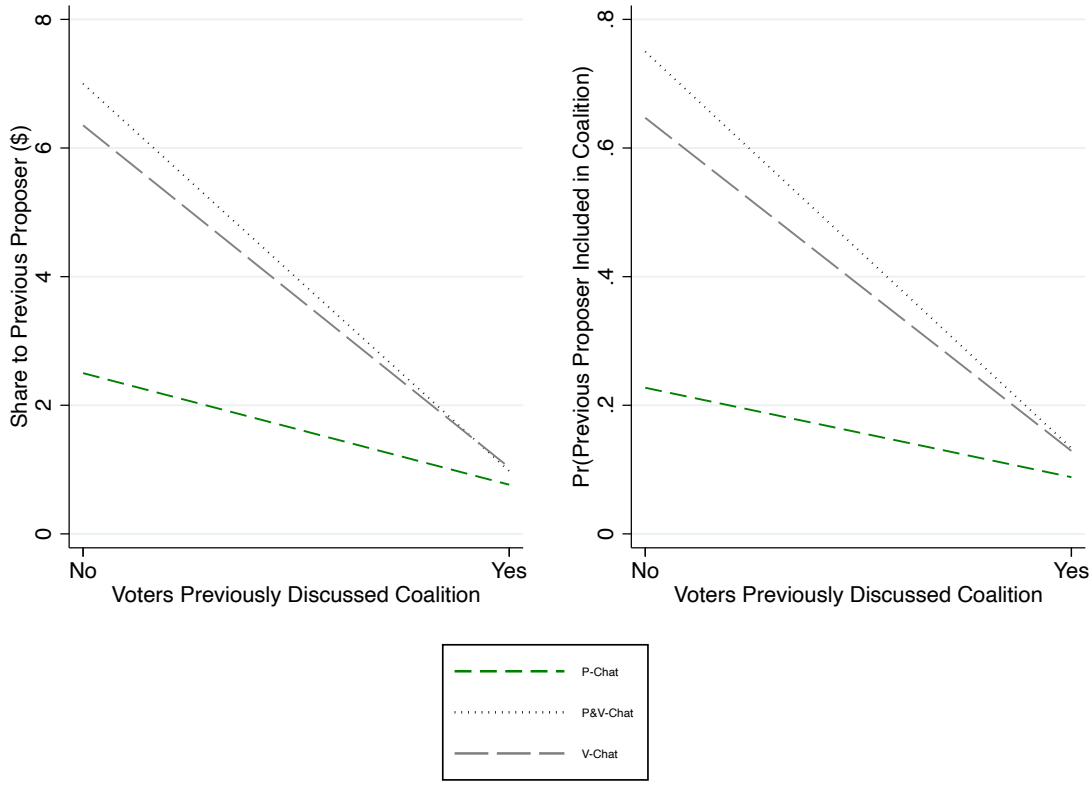
Appendix Figure C1 displays the distributions of proposers' (left panel) and voters' (right panel) stated desired shares across treatments with communication where this content category was coded (*P-Chat* and *P&V-Chat*). On average, proposers stated desired shares of \$17.63 in *P-Chat* and \$16.72 in *P&V-Chat*; voters stated desired shares of \$12.52 in *P-Chat* and \$12.82 in *P&V-Chat*.



Notes: This figure compares proposers' (left panel) and voters' (right panel) stated desired shares across treatments with communication where this content category was coded (*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 C1: **Proposer and Voter Desired Shares by Communication Treatment**

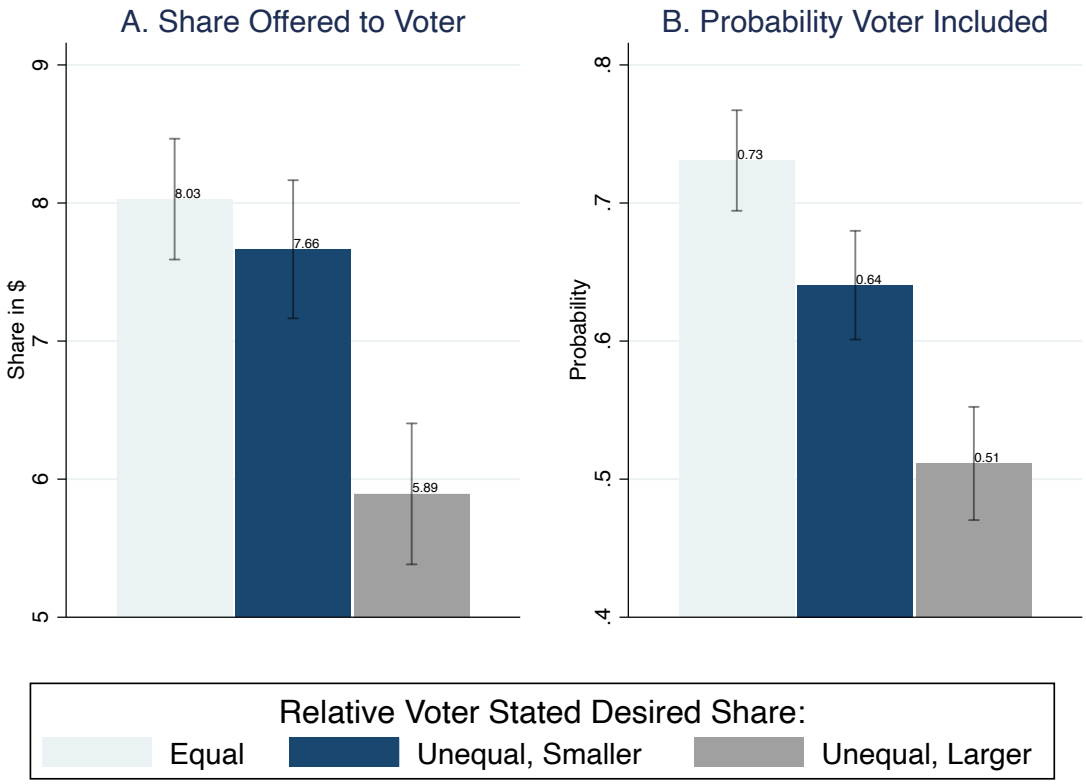
We observe that previous discussions of coalitions most influence previous proposer shares and probability of coalition inclusion in subsequent rounds in treatments with communication at the voting stage as compared with the proposal stage only.



Notes: These graphs show the predicted previous proposer share (left panel) and probability of inclusion in a coalition (right panel), by treatment assignment and whether voters had discussed forming a coalition in the previous period.

Figure C2: **Coalitions and Retaliation, by Treatment**

We observe that proposers tend to form coalitions with voters who state comparatively smaller desired shares.

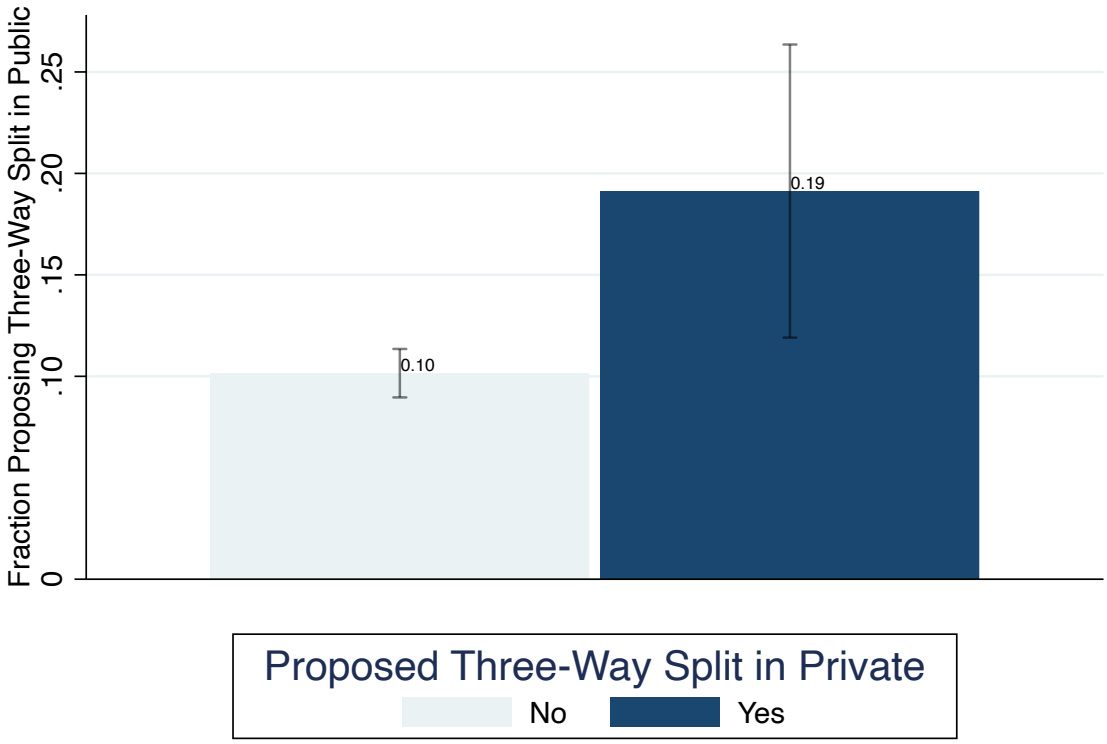


Notes: This figure displays the share offered to a voter, as well as the probability that they are included in a coalition, depending on whether they communicated a desired share that was a) equal to the other voter's stated desired share, b) unequal and the smaller of the two, or c) unequal and the larger of the two. 95% confidence intervals included.

Figure C3: **Desired Share and Coalition Formation**

The following figures evaluate whether individuals say different things in public versus private channels. We evaluate individuals' answers in public versus private channels for three-way splits, as this is a category that was a) coded for multiple chat boxes and b) observed with a high enough frequency to evaluate patterns.

First, as shown below, we find some overlap between what people call for in public and private: those who call for three-way splits in private (between the proposer and voter) are also more likely to call for three-way splits in public (19% versus 10%).

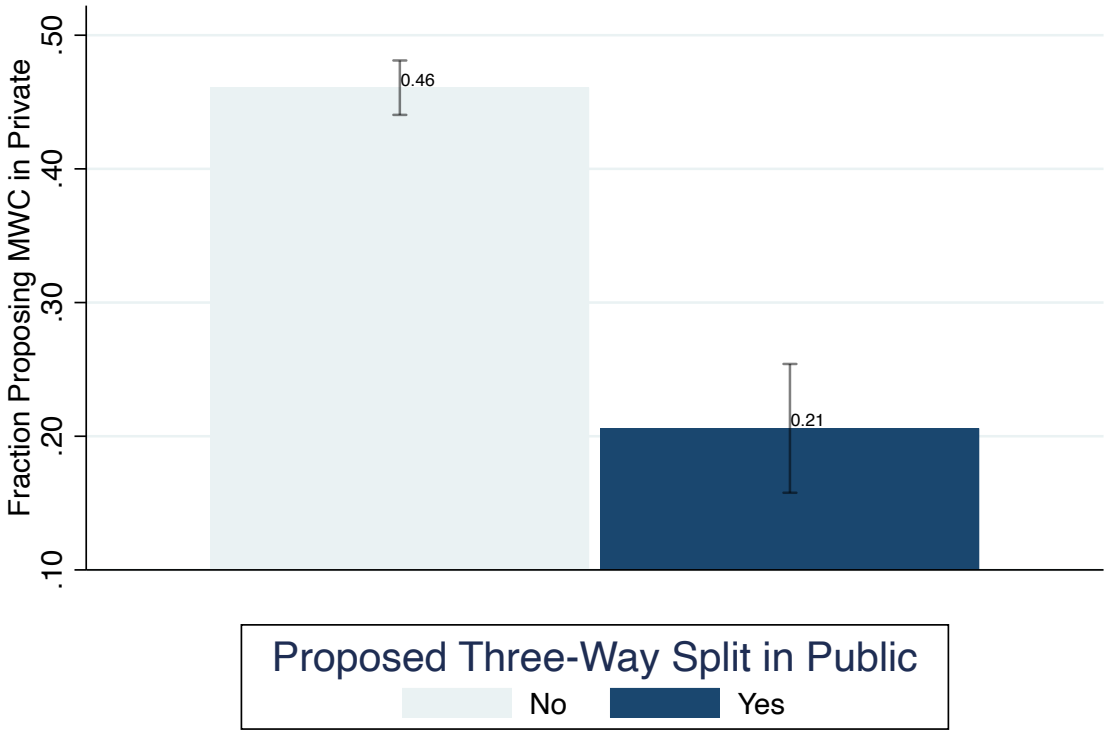


Notes: This figure displays the fraction of subjects who proposed a three-way split in the public chat box, based on whether they proposed a three-way split in private or not. 95% confidence intervals included.

Figure C4: **Messages Sent in Public Versus Private: Three-Way Splits**

Second, as shown below, we find that those who propose a three-way split in public are less likely to initiate discussions about a MWC in private (between a proposer and voter), indicating again some consistency across channels. That being said, we do find that 21% of those who suggest a three-way split in public initiate discussions about a MWC in private. However, we cannot with our current data say whether this is due to a deliberate intent to misrepresent intentions or instead

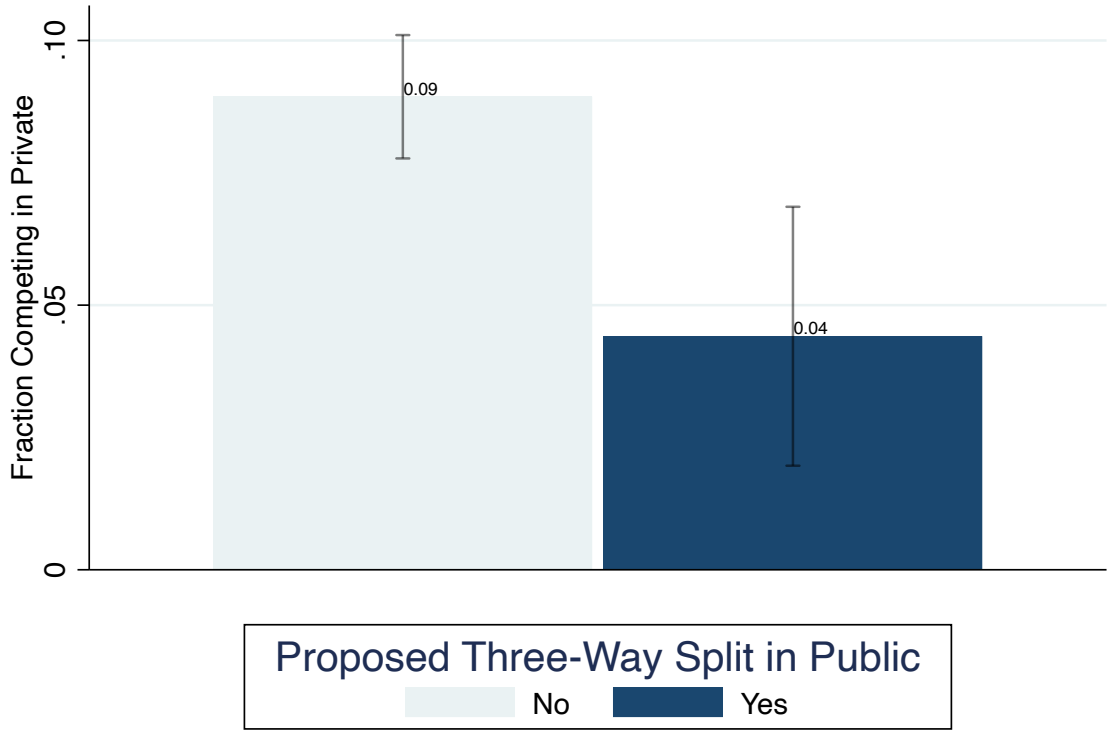
because a player decided to discuss a MWC only after their suggestion of a three-way split had been rebuffed in the public channel (as we lack data on the order of messages by their content).



Notes: This figure displays the fraction of subjects who proposed a MWC in a private chat box, based on whether they proposed a three-way split in the public chat box or not. 95% confidence intervals included.

Figure C5: **Messages Sent in Public Versus Private: MWC and Three-Way Splits**

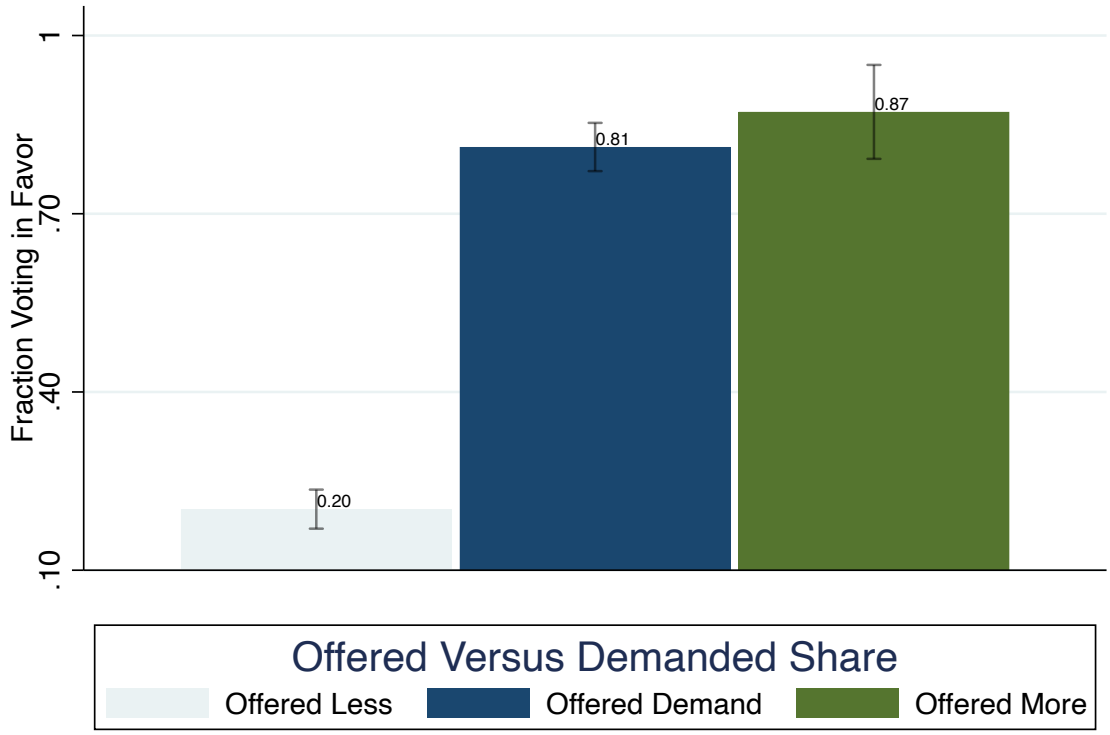
We observe a similar pattern as regards competition, as shown below.



Notes: This figure displays the fraction of subjects who engaged in competition in a private chat box, based on whether they proposed a three-way split in the public chat box or not. 95% confidence intervals included.

Figure C6: **Messages Sent in Public Versus Private: Compete and Three-Way Splits**

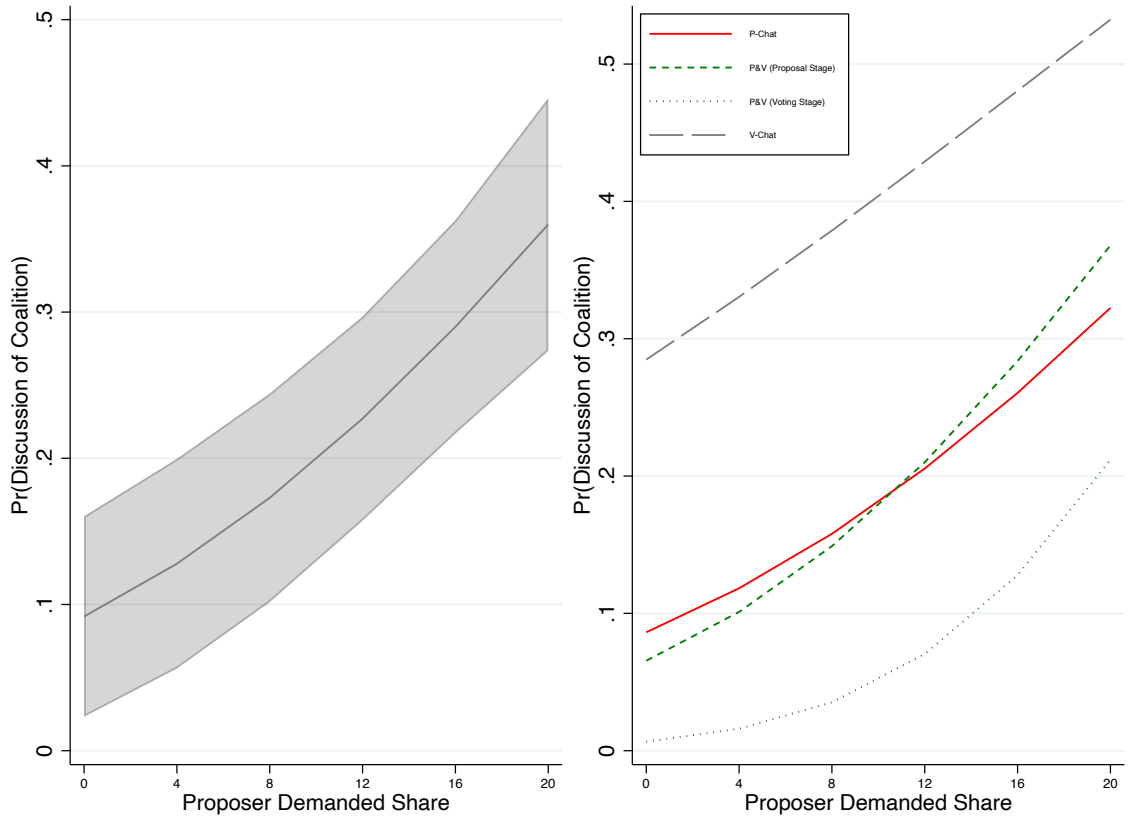
Do voters who communicate their desired share tend to support proposals that allocate them that share? Overall, we find (see Figure C7 below) that voters generally do not appear to be seeking to mislead proposers, as they vote in favor of proposals in 81% of cases where they are offered their exact demanded share (and 87% where the offered amount exceeds their demanded share). In contrast, only 20% of voters support proposals where they are offered less than their stated demanded share. Note, however, that we are only able to conduct these analyses on the subset of voters (approximately 50%) who state desired shares when given the opportunity.



Notes: This figure displays the fraction of voters voting in favor of a proposal based on whether they were offered less than the amount they demanded in communication, whether they were offered exactly what they demanded, or whether they were offered more than they demanded. We exclude voters who did not communicate desired shares to proposers. 95% confidence intervals included.

Figure C7: **Vote, Stated Desired Share, and Offered Share**

How does the content of communication vary depending on the proposal on the table? In the below figure, we find firstly (left panel) as we might expect that the likelihood that voters initiate discussions of future coalitions is increasing as a function of the proposer's demanded share of the pie. However, as shown in the right panel, this relationship does not vary meaningfully with treatment assignment or stage of bargaining (effects are not statistically distinguishable from zero).

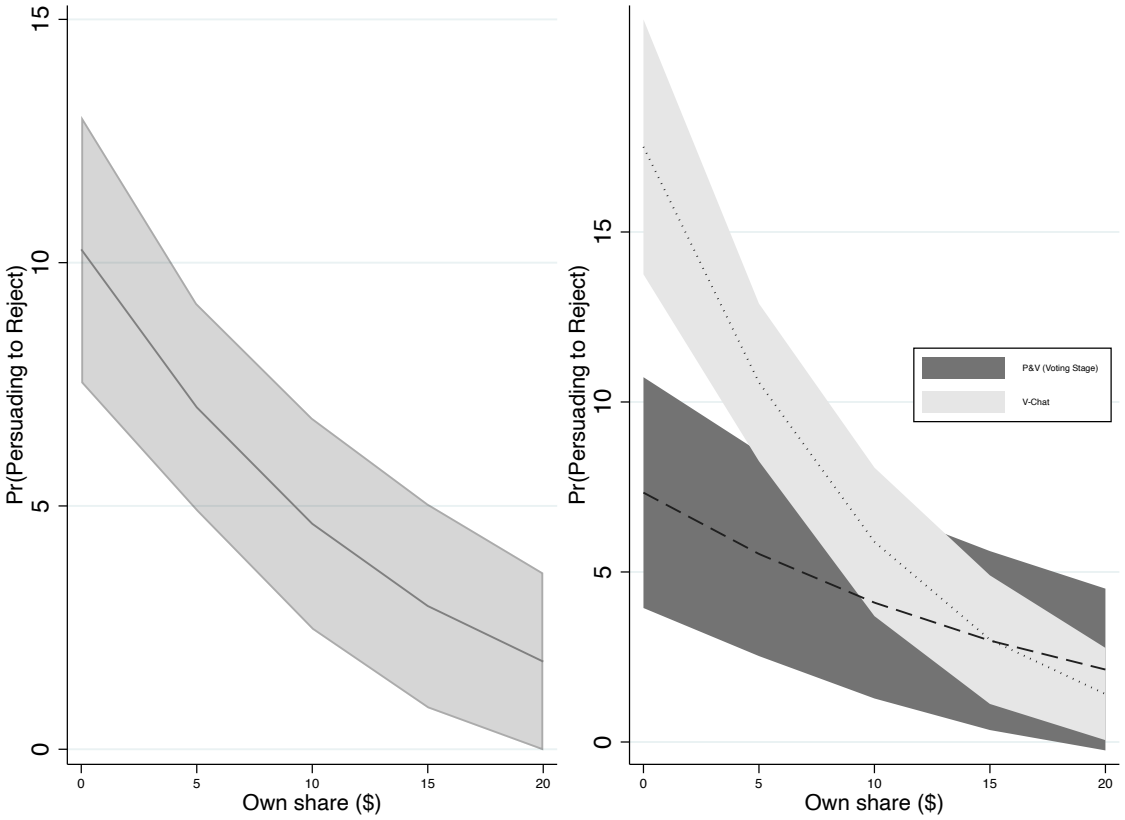


Notes: This figure displays the probability of a discussion of future coalitions occurring in a given round of play as a function of the proposer's demanded share, pooling across treatments and controlling for assignment (left panel) and separately for each treatment (right panel).

Figure C8: **Coalition Formation by Proposer Share and Treatment**

We similarly find (see Figure C9 below) that the likelihood that a voter seeks to persuade another voter to reject a proposal is decreasing as a function of the share they have been offered. This effect appears to be stronger in the voting stage in the *V-Chat* treatment as compared with the voting stage of the *P&V-Chat* Treatment, perhaps consistent with evidence elsewhere that voters are more active as regards persuasion and coalition formation when they are only permitted to communicate at the voting stage.

Finally, as shown in Figure 5, we also observe that communication content appears to be closely

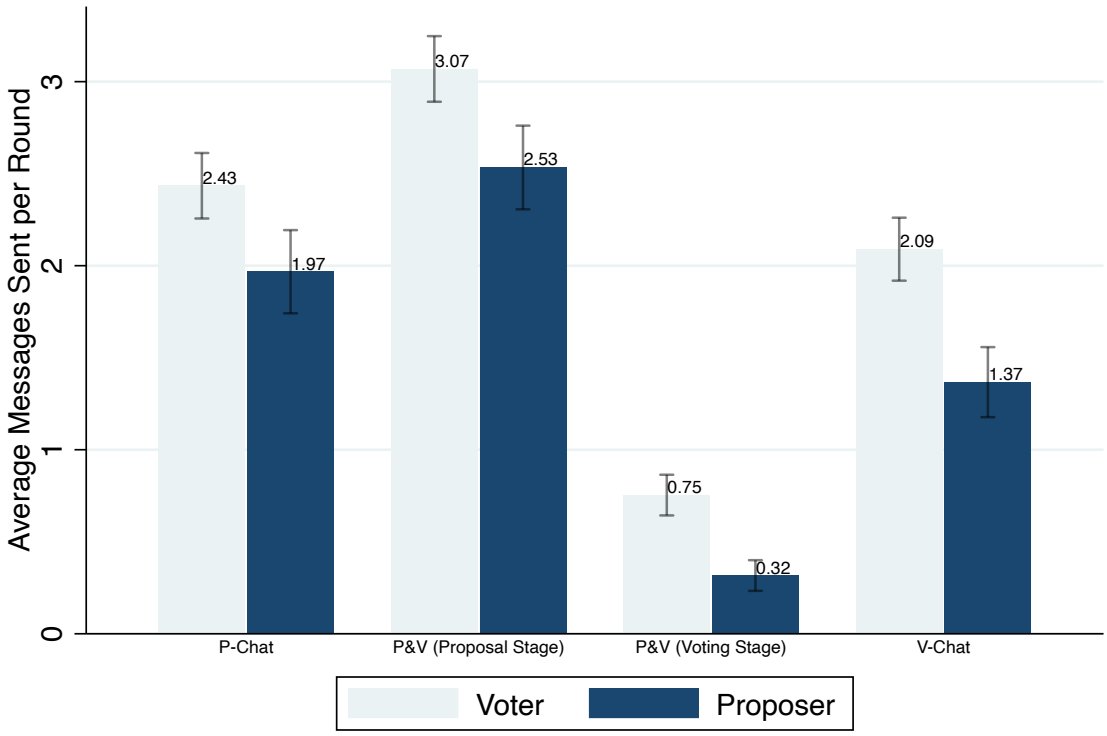


Notes: This figure displays the probability that a voter seeks to persuade another voter to vote against a proposal in a given round as a function of the share offered to the voter, pooling across treatments and controlling for assignment (left panel) and separately for each treatment (right panel).

Figure C9: **Persuasion by Proposer Share and Treatment**

related to proposal terms. In sum, we find evidence that communication content may be impacted by – and may impact – bargaining proposals.

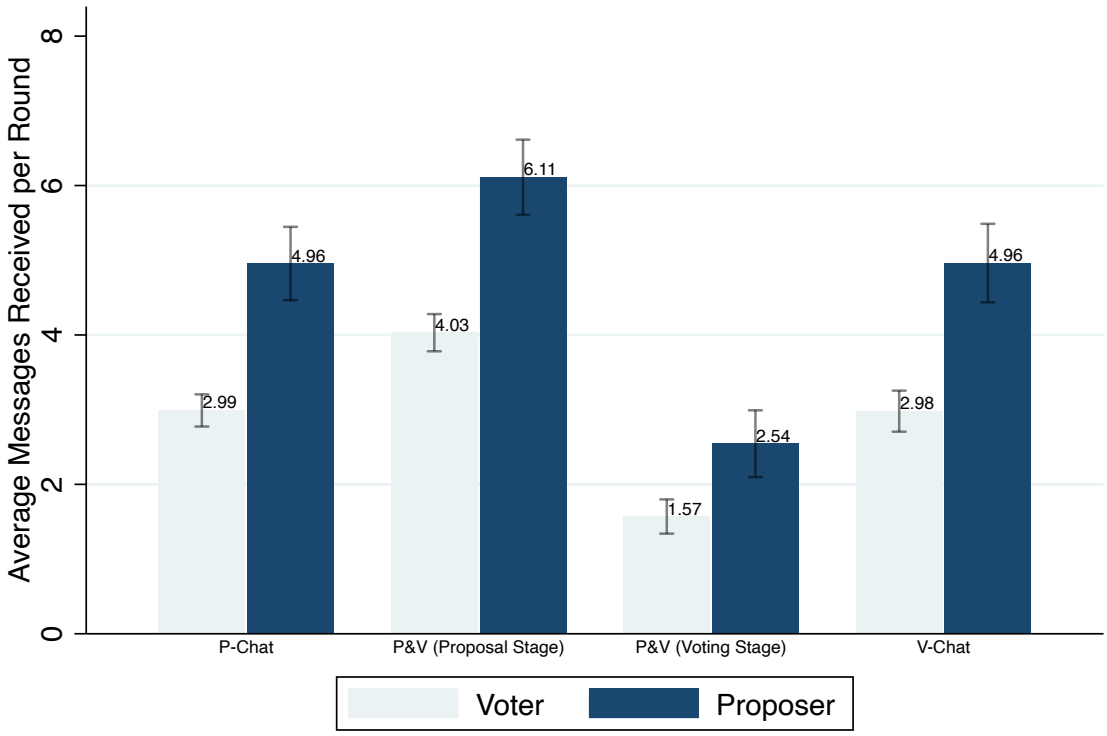
Across treatments, we observe that voters send more messages on average.



Notes: This figure displays the average number of messages sent in a given round, by subject role and treatment assignment. Note that more messages are recorded as received than sent because multiple members receive messages in the public chat. 95% confidence intervals included.

Figure C10: **Average Number of Messages Sent**

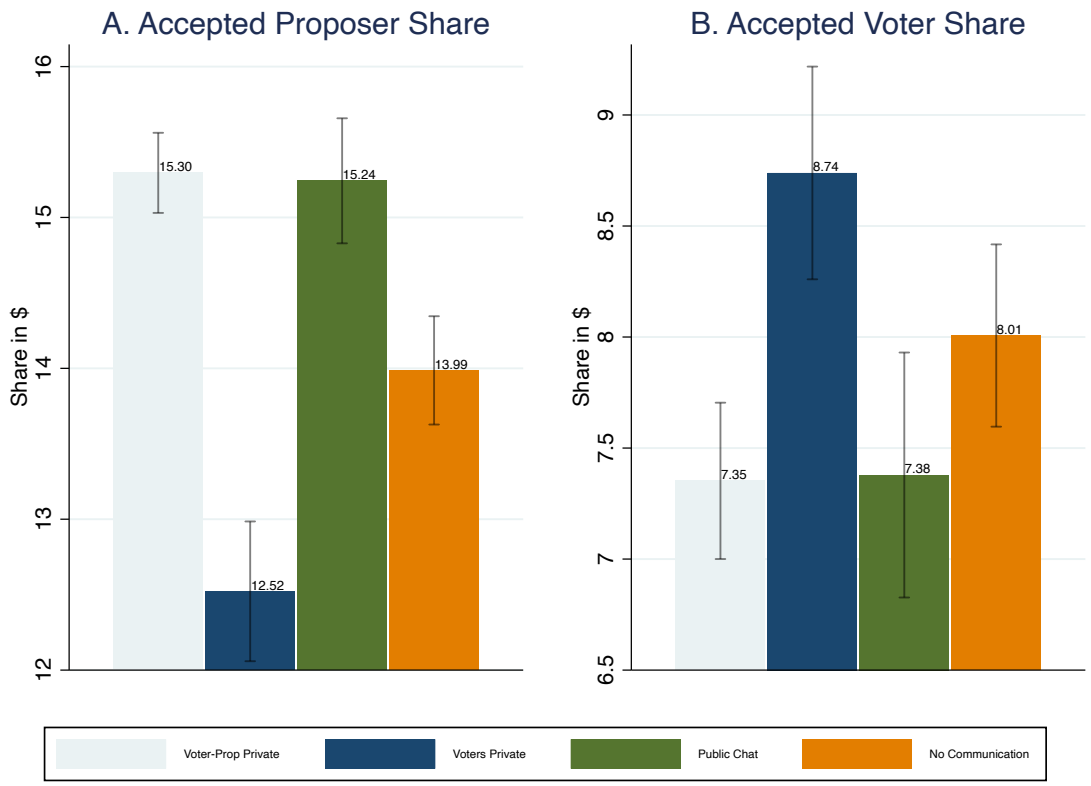
Across treatments, we observe that proposers receive more messages on average.



Notes: This figure displays the average number of messages received in a given round, by subject role and treatment assignment. Note that more messages are recorded as received than sent because multiple members receive messages in the public chat. 95% confidence intervals included.

Figure C11: **Average Number of Messages Received**

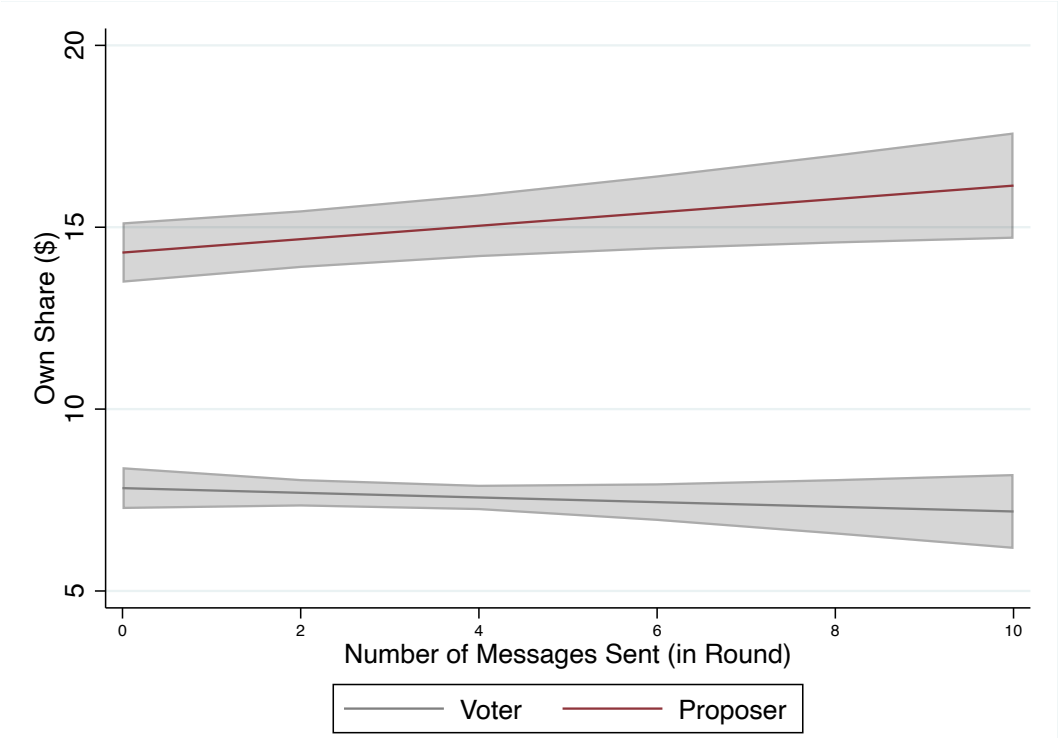
We observe that voters earn more on average – and proposers less – where the first message exchanged is in private between voters.



Notes: This figure displays the average accepted proposer (left panel) and voter (right panel) share by whether there was communication in a group and in which medium it was initiated. 95% confidence intervals included. We only include treatments where communication was possible.

Figure C12: **Proposer and Voter Accepted Share by Initiator (Medium)**

We find that proposers' shares, but not voters' shares, increase with the number of messages sent.



Notes: This figure displays the predicted share in an accepted proposal, separately for voters and proposers, and depending on the number of messages sent in a given round. We control for treatment assignment.

Figure C13: **Communication Volume and Accepted Shares by Subject Role**

C.2 Additional Regressions

	(1) Desired Share	(2) MWC	(3) 3-Way Split	(4) Compete	(5) Punish	(6) Con Accept	Con Reject	Coalition
Panel A: Medium								
Reference: Public Medium								
Proposer & Voter (Private)	-	0.74***	-0.15**	0.17**	0.02	0.06*	0.02	-
	-	(0.04)	(0.03)	(0.04)	(0.01)	(0.02)	(0.02)	-
Voter & Voter (Private)	-	-	-	-	0.01	-0.00	0.09***	0.33***
	-	-	-	-	(0.01)	(0.00)	(0.02)	(0.04)
N	859	1,718	1,718	1,718	810	2,835	2,835	2,622
Panel B: Subject Role								
Proposer								
Voter	0.00	0.11*	0.07**	-0.05	0.00	-0.07*	0.06***	0.25***
	(0.03)	(0.03)	(0.02)	(0.02)	(0.01)	(0.03)	(0.01)	(0.06)
N	2,577	2,577	2,577	2,577	810	2,835	2,835	2,872
Panel C: Treatment Assignment								
Chat Proposal & Voting Stages								
Chat Proposal Stage	0.02	0.01	-0.07	-0.07	-0.02	-	-	-0.06
	(0.07)	(0.07)	(0.08)	(0.07)	(0.04)	-	-	(0.11)
Chat Voting Stage Only	-	-	-	-	-0.04	0.13**	0.08	0.13
	-	-	-	-	(0.03)	(0.03)	(0.05)	(0.10)
N	859	859	859	859	270	945	945	1,311

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

Notes: This table displays the relationship between communication medium (panel A), subject role (panel B), and treatment assignment (panel C), 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.

Table C1: **Regression Results Corresponding to Figures 3 and 4**

	(1)
Reference: Chat Proposal & Voting Stages	
Chat Voting Stage Only	0.33***
	(0.06)
N	945

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

Notes: This table displays the relationship between coalition discussion at the voting stage and treatment assignment: either *P&V-Chat* or *V-Chat*. We cluster standard errors at the subject and session levels.

Table C2: **Coalition Discussion at Voting Stage by Treatment**

	(1) Proposed Share	(2) Probability of Inclusion
Coalition Discussed Previously	-9.87**	-0.73**
	(2.65)	(0.21)
To Previous Voter	6.33**	0.44**
	(1.54)	(0.11)
Coalition X Prev Voter	6.26**	0.39**
	(1.67)	(0.11)
N	368	368

* 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, and we control for treatment assignment.

Table C3: **Regression Results Corresponding to Figure 6 (Interaction)**

	(1) Any Comm	(2) Prop First	(3) Vot First	(4) Prop-Vot First	(5) Public First	(6) Vot-Vot First
Reference: P-Chat						
P&V (Proposal Stage)	0.01	0.06	-0.06	-0.36***	0.19***	0.16*
	(0.03)	(0.04)	(0.04)	(0.06)	(0.03)	(0.07)
P&V (Voting Stage)	-0.42***	-0.08	0.08	-0.36***	0.21***	0.15*
	(0.06)	(0.04)	(0.04)	(0.04)	(0.04)	(0.07)
V-Chat	-0.16**	0.03	-0.03	-0.16*	0.08	0.08*
	(0.05)	(0.04)	(0.04)	(0.06)	(0.04)	(0.03)
N	1804	1398	1398	1398	1398	1398

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

Notes: This table displays the relationship between communication order and treatment assignment. We cluster standard errors at the subject and session levels.

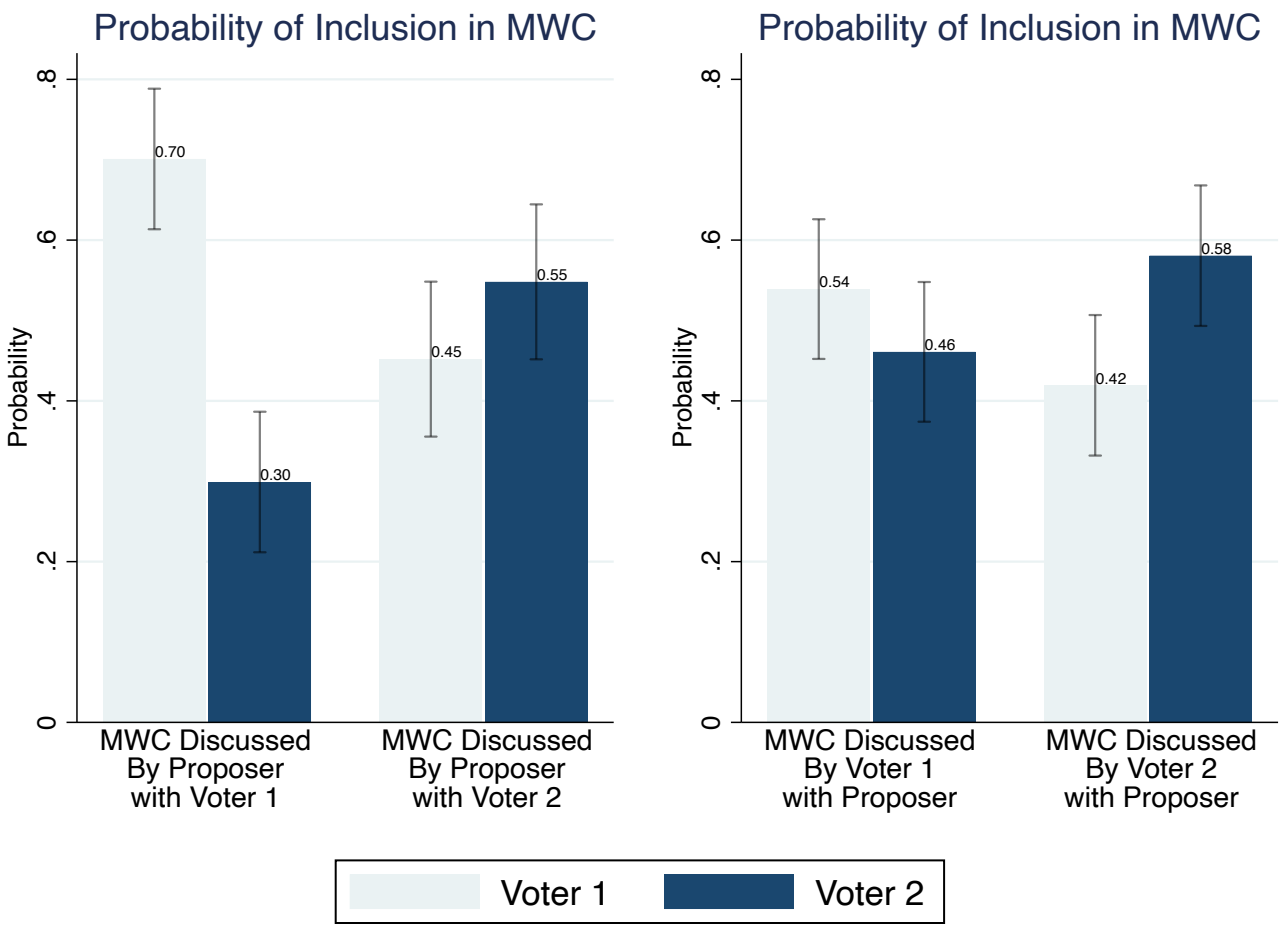
Table C4: **Regression Results Corresponding to Figure 7**

	(1) Proposer Share	(2) Voter Share
Reference: Proposer First		
Voter First	-0.60***	0.30***
	(0.14)	(0.07)
No Communication	-1.04**	0.52**
	(0.29)	(0.14)
N	1,457	2,914

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

Notes: This table displays the relationship between communication order and proposers' (column 1) and voters' (column 2) accepted shares. We cluster standard errors at the subject and session levels and control for treatment assignment.

Table C5: **Regression Results Corresponding to Figure 8**



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 C14: **MWC Formation by Discussion and Partner**