When Norms are Abandoned: Bargaining with Preselected Division Rules

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Abstract

We examine bilateral bargaining, where participants first select a preferred allocation norm among equal division, equal gain, and proportional division. When matched with another sharing the same norm, participants decide whether to adhere to the projected division or negotiate a different outcome. Experimental results reveal that norm abandonment occurs more frequently when allocations are perceived as unfair: high contributors in equal division and low contributors in proportional division. Attachment is sturdiest for strict equality and weakest for proportionality. Equal gain, a middle ground, is the most favored at both preselection and negotiation outcomes. Several applications in international conflicts are discussed.

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1 Introduction

Bargaining happens everywhere: within households, workplaces, business partnerships, and international dispute resolutions. However, the specific conditions that trigger bargaining are not always clear. When dividing common resources, individuals are assumed to follow a specific allocation norm. For instance, the equal split, which divides a shared pie evenly regardless of bargaining positions, reflects a preference for strict equality (or maximal redistribution). In more straightforward cases, bargaining would begin when two parties have conflicting division norms, such as equality versus equity. However, our focus is on situations where both parties share the same allocation principle: in such cases, what motivates someone to abandon their norm of resource division and negotiate for a different outcome?

To answer this question, we design an experiment where participants first indicate a preferred division rule and must later decide whether to adhere to their preselection when faced with different resource-division problems. Our approach draws inspiration from the experimental flow in Nielsen and Rehbeck's (2022) study, where subjects choose their preferred canonical axioms in the risk domain and subsequently receive feedback to correct their norm deviations in lottery choices. In our adaptation, we present participants with three focal points in bargaining outcomes: equal division (identical payoffs as half of the pie), equal gain (identical earnings on top of individual inputs) and proportional division (payoff allocation proportional to individual inputs). As highlighted by Takeuchi et al. (2022), these solutions represent an ideological spectrum: strict egalitarianism (equal division), liberal egalitarianism (equal gain), and libertarianism (proportional division). Arguably, when two individuals follow the same allocation norm, they share a similar perception of fairness. Previous research in economics and social sciences has identified equality and equity as society's fundamental norms of fairness, which can greatly influence decisions in resource-division problems (Deutsch 1975; Leventhal 1976; Lamm and Schwinger 1980; Albin 1993; Corgnet, Sutan, and Veszteg 2011). The equality norm is represented by the equal-division and equal-gain rules in our

design with nuances in interpretation: equal division enforces identical payoffs as the outcome (maximal redistribution), while equal gain requires only an equal split in the joint profits, considering differences in individual inputs (surplus redistribution). Conversely, the equity norm, which entails rewarding proportional to individual contributions, is precisely captured by the proportional-division rule. Featuring of equality and equity in our design further highlights an environment where these norms coexist but are potentially in conflict.

Though framed as decision-making for joint investment, our experiment offers insights into conflict resolution from multiple angles. The question of resource division can involve settling disputes over territories and resources (e.g., land control or water access), and addressing hostility (e.g., mutual de-escalation or disarmament). An equal division can be found 50-50 splits of disputed resources: the 1960 Indus Waters Treaty allocated three rivers each to India and Pakistan (Sarfraz 2013). Equal gain entails comparable improvements for all parties from the current situation: the 1959 Antarctic Treaty suspended territorial claims while promoting research collaboration and mutual non-ownership (Dodds 2010). Proportional division is evident in resource allocation based on pre-existing civilian presence: the adoptions of proportional representation in the legislatures of Burundi and Rwanda after the 1990s genocides aimed to ensure power-sharing across ethnic groups (Vandeginste 2014).

In the negotiation stage, we employ three bargaining environments, offering subjects different levels of freedom to coordinate demands: (1) the traditional Nash Demand Game (NDG), the most restrictive setting where communication is not possible (Nash 1953), (2) an NDG that allows communication, and (3) unstructured bargaining, the most flexible environment where communication and different allocation proposals are permitted. When matched with another sharing the same norm, subjects must decide whether to follow the allocations projected by their principle or negotiate a different outcome. Theoretically, following the chosen rules maximizes individual payoffs, as even the most flexible bargaining environment carries a risk of negotiation failure. Overall, a large majority of our sample (74%) decide to follow the

preselection, which indicates a high level of norm attachment. However, 48% of pairs that share the same norm still proceed to bargaining, as only one party's abandonment is needed to initiate negotiation.

We implement a real-effort task to assign asymmetrical bargaining powers in each pair, with the higher performer receiving a larger endowment. The size of the shared pie is then generated proportional to the combined individual inputs, which equal the earned endowments. The real-effort task is intended to induce a sense of entitlement that subjects attach to their initial holdings (Gächter and Riedl 2005; Kamijo and Yokote 2022). Indeed, in bargaining experiments where disagreement payoffs are randomly assigned, the equal split emerges as a strong focal point (Nydegger and Owen 1974; Corgnet, Sutan, and Veszteg 2011; Anbarci and Feltovich 2013; Birkeland and Tungodden 2013; Anbarci and Feltovich 2018). Conversely, in studies where bargaining positions must be earned, other division concepts, such as the Nash (1950) solution or the proportional solution, prevail over equal division (Baranski 2016; Feltovich 2019; Takeuchi et al. 2022). Earned wealth is further found to increase differential decisions from the equal split in other settings such as the dictator game or the ultimatum game (Cherry, Frykblom, and Shogren 2002; Ogawa et al. 2012; Korenok, Millner, and Razzolini 2017; Demiral and Mollerstrom 2020).

Among different factors that potentially motivate bargaining initiation, the size of the earned initial endowment is found to have thorough impact on behavior. The preselected division norm is abandoned by the high contributor attached to strict equality and the low contributor following proportionality. We posit that bargaining initiation in these cases is likely motivated by self-regarding perception of unfairness in the projected allocations. Furthermore, the frequency of abandonment is highest for proportional division and lowest for equal division, suggesting that attachment to proportionality (or equity) is less stable compared to attachment to equality. Overall, the equal-gain rule emerges as the most preferred in both preselection and negotiation outcomes, even for subjects who initially select other norms. We postulate

that this principle might appear as a compromise between the two ideological extremes. In our subsequent discussion, we highlight the prominence of the equal gain norm in various international conflict resolutions.

The next two sections delineate our theoretical foundations and experimental design. We outline the experimental procedure in Section 4 and specify our hypotheses in Section 5. The obtained results are analyzed in Section 6. Section 7 concludes the article with various discussions, including how our results reflect existing approaches to resolve the Israel-Palestine conflict.

2 Theoretical backgrounds

We consider a simple bargaining situation, where two players discuss the division of $M > 0$. For each player, there exist some payoffs x_i greater than the disagreement payoff v_i. The total pie M is further assumed to exceed the sum of disagreement payoffs $v_1 + v_2$. Thanks to this superadditivity condition, an agreement is predicted as the outcome of bargaining.

Our study focuses on two main bargaining environments: the Nash (1953) demand game (NDG) and unstructured bargaining. The NDG essentially comprises a single pair of demands (x_1, x_2), simultaneously made by the two bargainers in isolation from each other. If $x_1 + x_2 \leq M$, the two sides receive what they have demanded (x_1, x_2). Otherwise, if $x_1 + x_2 > M$, bargainers receive their disagreement payoffs (v_1, v_2). Non-cooperative bargaining theories predict several solutions based on the Nash equilibrium, including the efficient pure-strategy equilibria $x_1 > v_1$, $x_2 > v_2$, $x_1 + x_2 = M$ resulting in payoffs (x_1, x_2), and the inefficient pure-strategy equilibria $x_1 > M - v_2$, $x_2 > M - v_1$ leading to payoffs (v_1, v_2) (Anbarci and Feltovich 2018). The original NDG does not allow communication; however, cheap talk is found to greatly improve efficiency in this setting (Feltovich and Swierzbinski 2011).

Unstructured bargaining permits free exchanges of messages and allocation proposals, usually

within a time limit. A deal is reached when bargainers both agree to a feasible pair of payoffs $x_1 + x_2 \leq M$. When no agreement is reached within the allotted time, bargainers receive their disagreement payoffs (v_1, v_2). With its high flexibility, this environment is arguably a more accurate representation of bargaining in real life. Unstructured bargaining is typically analyzed within cooperative framework, focusing on the properties (axioms) of different solution concepts without guiding how to choose among them. Notable solutions in cooperative bargaining include the Nash (1950) bargaining solution (NBS), which seeks a payoff pair that maximize the multiplication of monetary gains (the Nash product); the Kalai-Smorodinsky (1975) solution (KSS) , which identifies an efficient allocation that rewards individual gains proportional to their maximal payoffs, and the egalitarian solution (Kalai 1977), which gives bargainers equal gains from the disagreement point.

We consider three principal bargaining solutions: equal division, equal gain, and proportional division. The equal division (also called "equal split") allocates exactly half of the total pie M to each of the two parties, regardless of their initial holdings. On the other hand, the equal-gain rule gives bargainers identical earnings (half of the shared surplus) from their disagreement payoffs (v_1, v_2). By definition, this division rule is the egalitarian solution in cooperative bargaining (Kalai 1977), but in our settings, it also aligns with the Nash and Kalai-Smorodinsky solutions (Nash 1950; Kalai and Smorodinsky 1975). In the NDG, the equal gain also matches the solution suggested by Harsanyi and Selten (1988) under risk dominance (Kamijo 2023). Lastly, the proportional division rewards bargainers in proportion to their initial endowments v_1, v_2, which are also their personal contributions to the shared pie M. This solution concept is found to prevail following proportional contributions to a joint production (Baranski 2016; Takeuchi et al. 2022). The following notions delineate what bargainers receive according to the three distribution rules:

- Equal division (ED): $x_1 = x_2 = \frac{M}{2}$
- Equal gain (EG): $x_1 = v_1 + \frac{M - v_1 - v_2}{2}, x_2 = v_2 + \frac{M - v_1 - v_2}{2}$

- Proportional division (PD): $x_1 = \frac{v_1}{v_1+v_2}M, x_2 = \frac{v_2}{v_1+v_2}M$

Though non-cooperative and cooperative theories do not predict a single dominant solution, equal division emerges as the most common in both the NDG and unstructured bargaining (Nydegger and Owen 1974; Corgnet, Sutan, and Veszteg 2011; Anbarci and Feltovich 2013; Birkeland and Tungodden 2013; Anbarci and Feltovich 2018). This allocation rule only underperforms other solutions in specific settings: when a real-effort task is implemented prior to bargaining (Feltovich 2019; Takeuchi et al. 2022), or when equal division leads to resource wastage (Galeotti, Montero, and Poulsen 2019; Pham, Veszteg, and Kamijo 2024).

3 Design

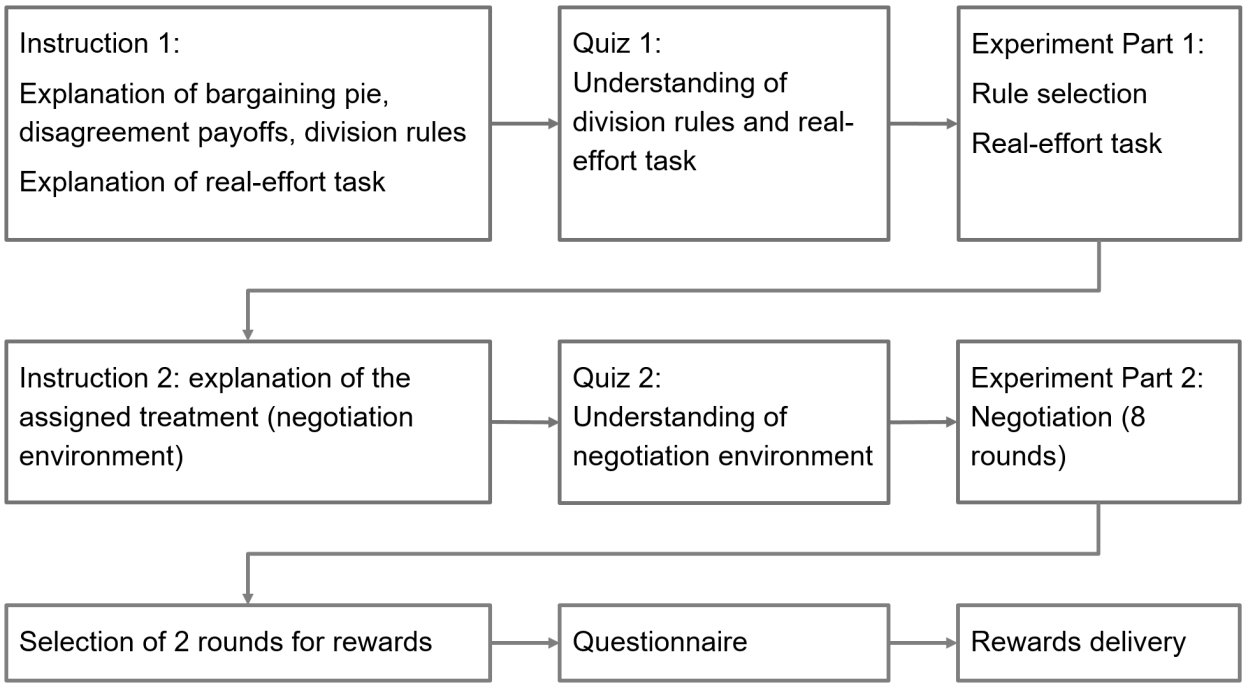


Figure 1: Summary of the experiment

Our experiment comprises two main parts: (1) rule preselection and real-effort task, and (2) negotiation. Figure 1 summarizes the experimental flow.

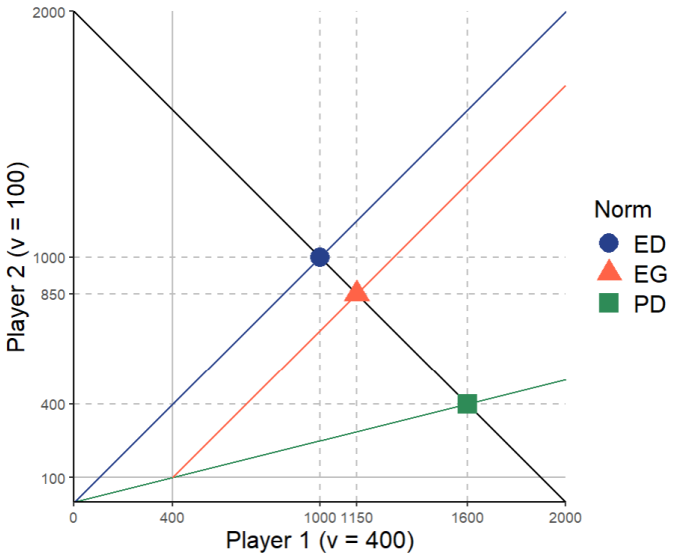


Figure 2: Example of payoff allocations according to the three norms. Note: the total pie is 2000; individual inputs are 400 for Player 1 (horizontal) and 100 for Player 2 (vertical).

3.1 Rule preselection and real-effort task

Inspired by the experiment of Nielsen and Rehbeck (2022), the core of our design involves participants choosing a preferred division norm (rule) at the beginning of the experiment. In our settings, allocations following equal-division and proportional-division norms are always at two opposites, while equal-gain payoff combinations remain in the middle, as shown in Figure 2's example.

It should be noted that in our design, v_i indicates both *initial holdings* and *disagreement payoffs*. Our instructions describe these values as endowments participants receive based on their performance in the real-effort task. Initial endowments for each pair are randomly drawn from two sets $\{100, 200, 300\}$ and $\{400, 500, 600\}$, with the better performer in the task receiving a value from the latter set. In the case of a tie, the program randomly selects the high and low performers. These amounts then must be fully invested in a shared pot, which is multiplied by a randomly chosen $\alpha > 1$, representing the return on investment and resulting in a total $M = \alpha(v_1 + v_2)$ between 1,000 and 2,000. Each subject is informed that they must decide on how to divide M with another participant in a later stage. If

this negotiation is unsuccessful, each party receives their initial holdings v_i. Because of the asymmetrical individual inputs in the shared pie, each pair comprises a high contributor and a low contributor. The total pie is generated proportional to the sum of individual inputs. We choose this particular approach for pie-size determination, as it is both straightforward to explain and closely resembles outcomes of joint investments in reality.

Following the division rule preselection, the slider task by Gill and Prowse (2019) was implemented to collect individual efforts. The task presents subjects with 48 sliders on a 0 to 100 scale, where subjects must move the computer mouse to exactly mark 50 within 3 minutes[1]. The slider task is a well-known tool in economic experiments to effectively capture individual differences without requiring preexisting knowledge.

3.2 Negotiation

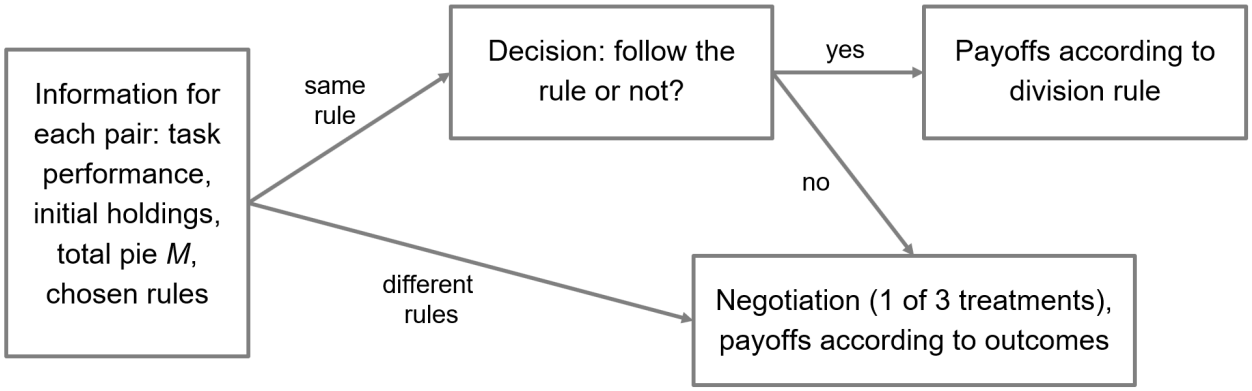


Figure 3: Summary of different paths in the negotiation stage.

As the negotiation stage begins, each pair is shown their performance in the slider task, as well as the randomly determined initial holdings (v_1, v_2) and total pie M. For pairs that select the same division norm in Part 1, subjects are reminded of their payoffs according to the chosen rule, and then must decide whether to follow the allocation. If either party chooses to abandon the preselected rule, the pair proceeds to the negotiation stage. If both

1. In the first session, we set the task's time limit at 5 minutes. However, due to time constraints, we shortened the task to 3 minutes in subsequent sessions. This discrepancy is taken into account in the following analyses.

sides agree to follow the chosen rule, bargaining is skipped and payoff allocation is based on the division norm. For pairs selecting different rules, subjects are informed of each other's norm, then proceed to negotiation. A summary of different paths in the negotiation stage is illustrated in Figure 3.

Three treatments are examined in our negotiation stage: a Nash demand game (Nash 1953) without communication (N), a Nash demand game with communication (NC), and unstructured bargaining (UB). In Treatment N, subjects immediately enter the decision-making stage, where each side inputs a demand for their personal payoff. In Treatment NC, subjects first have one minute to exchange messages before proceeding to the same Nash Demand Game. Subjects only have one shot to make their proposals in the two NDG treatments. In Treatment UB, each pair is given three minutes to freely exchange messages, as well as propose, retract, reject and accept allocations. Only feasible allocations (not exceeding the total pie) are allowed.

Negotiation succeeds if the sum of demands does not exceed the total pie in Treatments N and NC, and if bargainers reach a deal within the time limit in UB. In such cases, the bargainers' payoffs are the agreed allocations. Negotiation fails when the sum of demands is greater than M in the NDG, and when no deal is reached when the clock runs out in unstructured bargaining. In these scenarios, bargainers' payoffs are their initial endowments (v_1, v_2).

In our experiment, the negotiation stage was repeated eight times, with each subject randomly matched with a new opponent every round.

4 Experimental procedures

Our study recruited a total of 114 students (40% female) through the university's internal research participation system. Eight experimental sessions, each lasting around 90 minutes,

were conducted from November 2023 to February 2024. Except for the instructions and understanding quizzes, the entire experiment was implemented on zTree (Fischbacher 2007). At the end of each session, we administered a post-experiment questionnaire to collect demographic information, including age, gender, academic major and risk tolerance[2].

Upon arrival, participants received the first set of instructions via PowerPoint slides displayed on their personal computers in the laboratory. The instructions provided an overview of all experimental stages and detailed explanations of the three distribution rules, accompanied by graphical illustrations and examples. Subjects were informed that they must choose their preferred distribution rule, which might impact their final payoffs. Subsequently, the instructions described the real-effort task, wherein each participant's performance would determine their initial endowment in the decision-making stage. We further highlighted that the pie size was generated proportional to individual inputs. The nature of the negotiation environment (the NDG or unstructured bargaining) is not described in the first set of instructions. A quiz followed to test participants' understanding, requiring correct answers (re-attempts allowed).

In the first z-Tree screen, participants were asked to choose a preferred division rule between the three presented. The experimental screen also recapped the rules' definitions with graphical explanations. After selecting their preferred rule, subjects proceeded to the real-effort task and received their performance score upon completion.

Following the real-effort task, instructions for the negotiation stage were delivered via PowerPoint slides. Participants were informed about the specific conditions of their bargaining environment (one of the three treatments), as well as reminded about how their initial holdings and shared pie were determined in each matching. Previews of negotiation screens were also provided to all participants. After the instructions, a second quiz was administered to ensure subjects' understanding. Subjects then proceeded to eight rounds of negotiation.

2. Subjects were asked to indicate their risk attitude on a scale from 0 ("not at all willing to take risks") to 10 ("very willing to take risks"), adapted from Dohmen et al.'s (2011) methodology.

After the negotiation stage, we disclosed the outcomes of reward randomization. All participants received a show-up fee of 1,200 Japanese yens (JPY). In addition, the results of two of the eight rounds in Part 2 were randomly chosen to determine monetary rewards at a 1-to-1 conversion rate. The average final payoff was JPY 2,430, equivalent to USD 20.7 in purchasing power parity (IIMA 2024) and well above the local hourly minimum wage of JPY 1,113 (MHLW 2024).

There were two instances where additional data cleanup was necessary. One subject felt sick and left the laboratory in the last two bargaining rounds, but returned during the demographic questionnaire and reward delivery. Therefore, the data related to this participant and the matched opponent in these two rounds were excluded. Furthermore, one subject seemed to misunderstand the payoff units and made NDG demands of only 3 yens in the first two periods, but later increased them to 500-1000 in subsequent rounds. Therefore, we filtered out the bargaining data for the first two pairs involving this participant.

5 Hypotheses

Our design features subjects selecting their preferred distribution rule prior to the real-effort task and negotiation. We posit that the chosen rule reflects a norm held by the decision-maker. Therefore, we are first interested in the selection rates of the three division rules. As the total pie is generated proportionally to the individual inputs, we expect the proportional division rule to be the most commonly selected, following the findings of Takeuchi et al. (2022) and Baranski (2016). Our first hypothesis is as follows:

Hypothesis 1: *Proportional division is predominantly chosen as the preferred allocation norm at the preselection stage.*

Our central research interest concerns what conditions trigger a party to forgo their norm to initiate bargaining when the norm is also shared by their opponent. Intuitively, we

anticipate more norm abandonment when subjects perceive their projected payoff as unfair, such as the low contributor with the proportional-division norm and the high contributor with the equal-split norm. As the participants' initial holdings v_i are decided by their task performance and can impact their projected payoffs, the size of v_i is expected to influence the decision to initiate negotiation. Furthermore, our three treatments offer varying levels of communication and proposal freedom. We hypothesize that more bargaining occurs when (1) subjects have the ability to exchange messages (in the *UB* and *NC* treatments compared to the *N* treatment), and (2) when subjects have the freedom to propose different allocations (in unstructured bargaining compared to the two NDG environments). Thus, we expect more bargaining initiation in the *UB* treatment, followed by *NC*, then *N*. Our hypotheses related to the primary research question are:

- Hypothesis 2a: *Subjects with the equal-division norm are more likely to abandon their preselected allocation rule when their initial endowments are higher.*
- Hypothesis 2b: *Subjects with the proportional-division norm are more likely to abandon their preselected allocation rule when their initial endowments are lower.*
- Hypothesis 2c: *Norm abandonment is the most frequent in the UB environment, followed by NC, then N treatments.*

Regarding bargaining outcomes, we expect subjects in unstructured bargaining, the most flexible environment to coordinate allocations, to reach agreements most frequently, followed by the *NC* treatment, and then the *N* treatment. This expectation aligns with Feltovich and Swierzbinski's (Feltovich and Swierzbinski 2011) findings on how communication improves the NDG's outcomes. Moreover, as the shared pie M is generated proportionally to individual inputs, we expect individual demands in the NDG and unstructured bargaining outcomes to align the closest with the proportional division rule, following the results of Takeuchi et al. (2022) and Baranski (2016). Our hypotheses for bargaining outcomes are the following:

- Hypothesis 3a: *For pairs that proceed to bargaining, the UB treatment has the highest*

rate of agreement, followed by NC, and then N.

- Hypothesis 3b: *In the NDG, individual demands lie the closest to the projected payoffs of proportional division.*
- Hypothesis 3c: *In unstructured bargaining, agreed allocations lie the closest to the projected payoffs of proportional division.*

6 Results

6.1 Rule selection

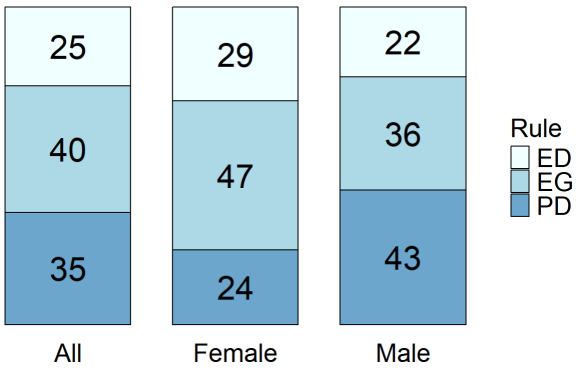


Figure 4: Selection rates in percentages of the three division rules overall and by gender

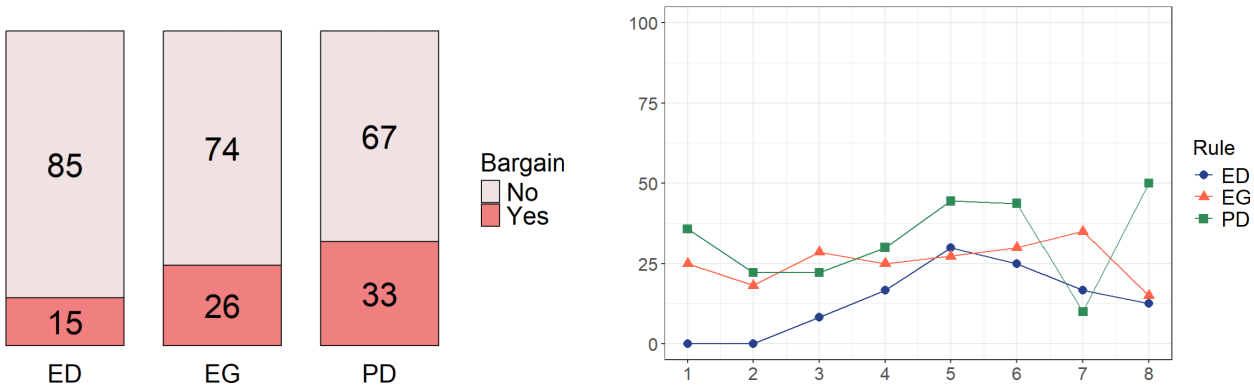
No clear winner emerges among the three division norms at the preselection stage, as summarized in Figure 4. Equal gain is the most favored norm at 40% of choices, followed by proportional division at 35% and equal division at 25%. Binomial tests show that the ED rule is significantly distant from a 33.3% benchmark, but not the other two rules ($p = 0.03$ for ED, $p = 0.1$ for EG and $p = 0.59$ for PD). These results align with previous observations that indicate the equal split is far less common when bargainers must earn their disagreement payoffs through real-effort tasks (Feltovich 2019; Takeuchi et al. 2022). However, contrary to the findings of Baranski (2016) and Takeuchi et al. (2022), our data does not confirm a clear prevalence of proportional division when the pie size is generated proportional to individual inputs. Thus, Hypothesis 1 is not supported.

Our secondary analysis finds that gender plays an influential role in norm selection. Among female participants, the equal-gain rule is the most popular (selected by 47%), followed by equal division (29%) and proportional division at (24%). In contrast, male bargainers most frequently favor proportionality (43%), followed by equal gain (36%) and equal division (22%). The Fisher's exact test and Pearson's correlation test identify weakly significant differences in the distribution of selected rules between genders ($p = 0.07$ in Fisher's exact test and $p = 0.08$ in Pearson's test). Simple logistic regressions between rule preference and gender reveal that female participants are 58.5% less likely to choose the *PD* norm ($p = 0.03$). Importantly, rule selection was implemented prior to the real-effort task, meaning that decisions are solely driven by subjects' preference for a specific division norm, not by their subsequent performance and initial endowments. Among female participants, the unpopularity of proportional division, embedded with the highest level of payoff inequality, aligns with Pham, Veszteg, and Kamijo's (2024) results, which identify women's preference for equality and men's inclination toward efficiency in bargaining. Additionally, these patterns in gender differences are also found in other economic decisions (Andreoni and Vesterlund 2001; Sharma 2015; Austermann et al. 2024).

Lastly, it is important to note that our subjects were not informed about the bargaining environments (the NDG or unstructured bargaining) when they selected their preferred division norm at the first part of the experiment. Therefore, analyzing rule preselection across different treatments would be irrelevant.

6.2 Norm abandonment

To address our central research question, we examine the decision whether to abandon preselected division rules and negotiate for a different outcome. Our sample includes all subjects matched with opponents that share the same norm. Table 2 summarizes the results of our analyses on bargaining initiation, first with linear probability models (LPM) of three subsamples for the norm groups, as well as linear and logistic regression models for the overall



(a) Overall (b) Across periods

Figure 5: Percentages of subjects that initiate bargaining by division norm

dataset. The Appendix's Table A.1 provides further regression results for subsamples of high contributors and low contributors within each pair. The LPMs are employed to identify relationships between a wide range of covariates and the outcome variable. On the other hand, the logistic model, prone to convergence failure when the number of regressors are high and the sample size is small, is utilized to confirm the relationships of the main predictors on the target variable (as a robustness check for the LPM results). All models include a random effect for each subject. In addition, Figure 5 illustrates the gap in bargaining initiation between the three division rules cumulatively on the left and across periods on the right. Figure 6 portrays the same comparisons but between three bargaining environments.

Overall, the majority (74%) of individuals who share the same norm with their opponents follow through with their preselection. However, since only one party's norm abandonment is required to start the bargaining stage, 48% of pairs with the same division rule proceed to negotiation.

Per our hypotheses, we expect opposite behaviors among the norms: bargaining is initiated by high contributors attached to equal division and low contributors following proportional division. Regression Models (1), (2) and (3) for the norm-group subsamples highlight these relationships. Furthermore, to capture these links in Models (4) and (5) for the overall dataset, we include an interaction term between the initial holdings and the norm type (the

ED norm is used as the baseline).

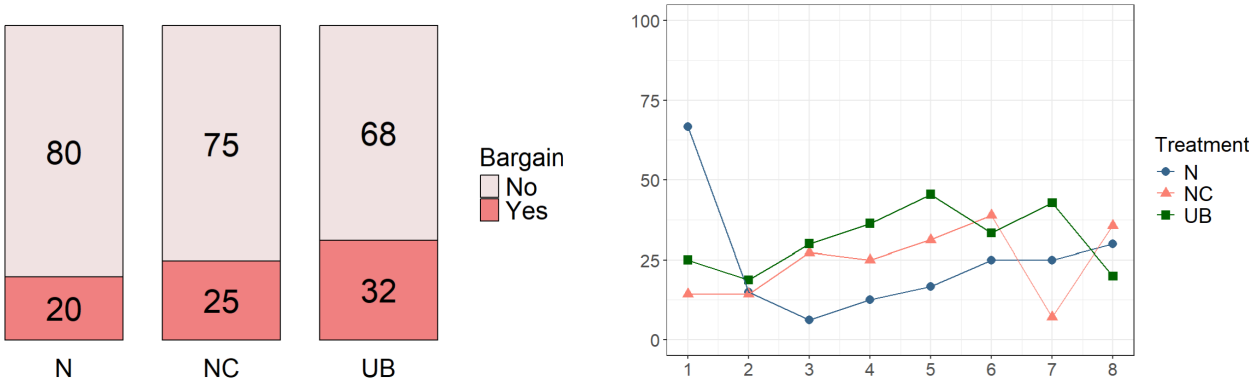
Initial endowment	100	200	300	400	500	600
Norm ED	0	0	0	7.1	35.7	66.7
Norm EG	33.3	16.7	21.9	27.6	24.0	28.1
Norm PD	89.5	65.5	35.3	5	0	0

Table 1: Percentage of bargaining initiation by norm group and size of initial endowment

The size of the earned initial holdings v_i appears to have the most thorough impact on the decision to abandon preselected norms. In the equal-split group, the endowment size is positively correlated with bargaining initiation: a JPY 100 increase in v_i boosts the likelihood to start negotiation by 8.9%, as captured Model (1)'s results ($p < 0.01$). This trend persists in the high-contributor subsample in the Appendix's Table A.1, as those with a higher initial endowment attached to strict equality are significantly more inclined to start negotiation ($p < 0.01$). Of the 66 matchings of subjects sharing the ED norm, 20 pairs proceed to bargaining, all of which are initiated by the high contributors. Furthermore, only 1 out of 14 high contributors (7.1%) with a v_i of JPY 400 decides to abandon the ED norm, while this rate is 35.7% for $v_i = 500$ and 66.7% for $v_i = 600$, as shown in Table 1.

In contrast, participants with lower initial holdings in the proportional-division group have significant tendency to initiate bargaining. As highlighted by Table 2's Model (3), earning an additional JPY 100 in v_i reduces norm abandonment by 18.2% for individuals attached to proportionality ($p < 0.01$). In this norm group, 42 out of 43 bargaining scenarios (97.7%) are initiated by the low contributors. Furthermore, the bargaining initiation rate drastically declines as the endowment level increases, from 89.2% for $v_i = 100$ to only 5% for $v_i = 400$ and 0% for the two highest endowment levels, as Table 1 illustrates.

Lastly, the equal-gain group appears to represent a middle ground, as the norm is abandoned by 21 low contributors and 23 high contributors over a total of 44 cases of bargaining initiation. The coefficient for *Endowment* is not significant in the linear Model (2) for the EG norm group ($p = 0.51$), while Table 1 indicates no clear trend between the size of v_i and the rate of



(a) Overall (b) Across periods

Figure 6: Percentages of subjects that initiate bargaining by treatment

norm abandonment. In the last two regression models for the overall dataset (Models (4) and (5) of Table 2), the coefficients for $Endowment$ and $Endowment \times NormEG$ mostly cancel out each other.

Overall, the patterns above suggest that norms are likely abandoned by subjects who perceive their projected allocation as unfair, in particular high contributors following strict equality and low contributors initially attached to proportionality. Therefore, Hypotheses 2a and 2b are confirmed.

In Figure 5, which illustrates differences between the three rules, proportional division appears to cause the highest frequency of norm abandonment at 33%, while equal division is foregone by only 15% of followers. Indeed, bargaining is initiated significantly more frequently in equal gain and proportional division compared to equal division, as shown in the significance of variables $NormEG$ and $NormPD$ in Model (4) ($p = 0.01$ for $NormEG$ and $p < 0.01$ for $NormPD$). Furthermore, in an alternative to Model (4) with EG as the base norm, subjects following proportional division are also significantly more likely to proceed to negotiation than those sharing the equal-gain principle ($p < 0.01$). In short, these findings highlight that among the three ideologies, attachment is the most stable for strict equality, and the least stable for proportionality.

	Initiate bargaining				
Model	(1)	(2)	(3)	(4)	(5)
Regression	Linear	Linear	Linear	Linear	Logistic
Sample	Norm ED	Norm EG	Norm PD	All	All
Endowment (× 100 JPY)	0.089***	-0.012	-0.182***	0.100***	2.637***
	(0.019)	(0.019)	(0.018)	(0.027)	(0.963)
Norm *EG*				0.331***	12.021**
				(0.128)	(4.882)
Endowment × Norm *EG*				-0.114***	-2.747***
				(0.031)	(0.985)
Norm *PD*				0.986***	18.976***
				(0.143)	(5.164)
Endowment × Norm *PD*				-0.276***	-4.738***
				(0.033)	(1.095)
Treatment *NC* (vs *N*)	0.387***	0.254	-0.054	0.172*	1.561**
	(0.104)	(0.186)	(0.167)	(0.091)	(0.761)
Treatment *UB* (vs *N*)	0.661***	0.382**	-0.154	0.236**	1.784**
	(0.146)	(0.180)	(0.172)	(0.097)	(0.768)
Pie size (× 100 JPY)	0.0002	-0.014	0.007	-0.004	
	(0.010)	(0.011)	(0.009)	(0.006)	
Round (1 to 8)	-0.009	-0.007	0.030**	0.002	
	(0.017)	(0.014)	(0.015)	(0.009)	
Prior failed negotiations	0.276***	0.049	-0.043	0.047*	
	(0.057)	(0.038)	(0.038)	(0.025)	
Length of effort task (mins)	0.037	-0.010	-0.090	-0.006	
	(0.095)	(0.113)	(0.085)	(0.054)	
Tied in performance	0.147	0.296**	0.019	0.124*	
	(0.128)	(0.134)	(0.088)	(0.070)	
Male	-0.075	-0.013	-0.040	-0.032	
	(0.085)	(0.084)	(0.089)	(0.054)	
Risk tolerance (0 to 10)	0.014	0.031*	-0.004	0.013	
	(0.016)	(0.018)	(0.018)	(0.011)	
Constant	-0.580	0.082	1.118**	-0.246	-15.037***
	(0.415)	(0.535)	(0.454)	(0.263)	(5.034)
Observations	66	172	130	368	368

*$p < 0.1$, **$p < 0.05$, ***$p < 0.01$. Standard errors in parentheses.

Table 2: Determinants of individual decision to initiate bargaining

As shown in Figure 6, the unstructured bargaining environment leads to the highest rate of bargaining initiation at 35%, followed by the NDG with communication (25%) and without communication (20%). Model (4)'s results reveal that subjects are 23.6% more likely to abandon their norm in the *UB* environment compared to the NDG without communication ($p < 0.01$). This outcome aligns with our prediction, as the *UB* treatment allows greater flexibility in both communication and the ability to propose various allocation combinations. In addition, participants also start negotiation 17.2% more frequently when the NDG allows communication, albeit with a weak statistical significance in Model (4) ($p = 0.06$). However, no significant difference in bargaining initiation between the *UB* and *NC* is identified ($p = 0.3$).[3] In short, Hypothesis 2c is partially confirmed, with significant differences between *N* and the other two treatments, but not between *NC* and *UB*.

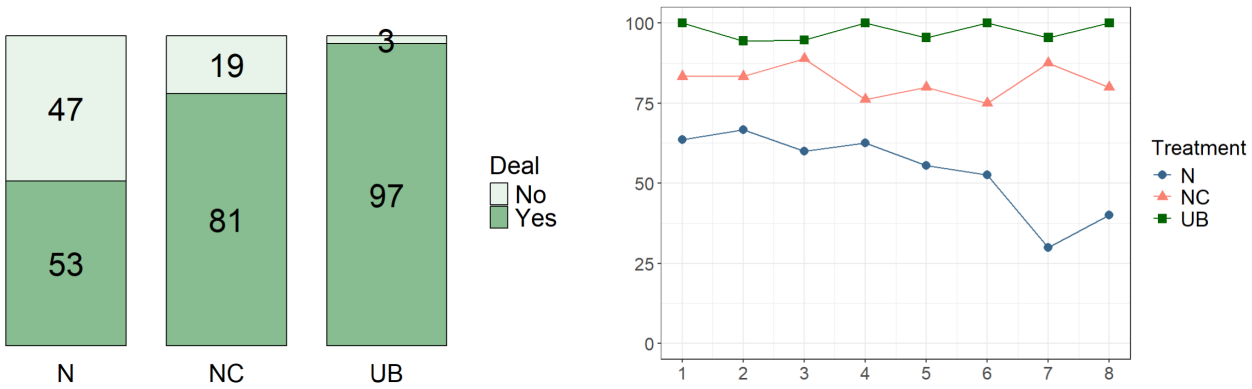
Notably, the size of the total pie M does not strongly affect bargaining initiation. In our design, the pie size is restricted between JPY 1,000 and 2,000. However, we could observe divergent behaviors if M has a wider range, as found by Camerer, Nave, and Smith (2019). We might expect less bargaining initiation when M grows very large, as not following the norm carries a risk of losing a significant monetary reward.

Some control variables also influence the decision to initiate bargaining, but only in certain subsamples. Participants in the PD norm group appear to proceed to negotiation more frequently in later rounds ($p = 0.046$). In the ED group, bargaining is more likely initiated by individuals with higher experience in failed negotiation ($p < 0.01$). Subjects that share the same score in the real-effort task as their opponents are more inclined to abandon the EG norm ($p = 0.03$). The remaining control variables do not appear to significantly impact bargaining initiation. These predictors include the duration of the real-effort task (3 or 5 minutes), the subject's gender and their attitude toward risk.

3. When we change the base treatment to *UB* in Model (4), no significant difference in the decision to initiate bargaining is identified between treatments *UB* and *NC* ($p = 0.3$).

6.3 Bargaining outcomes

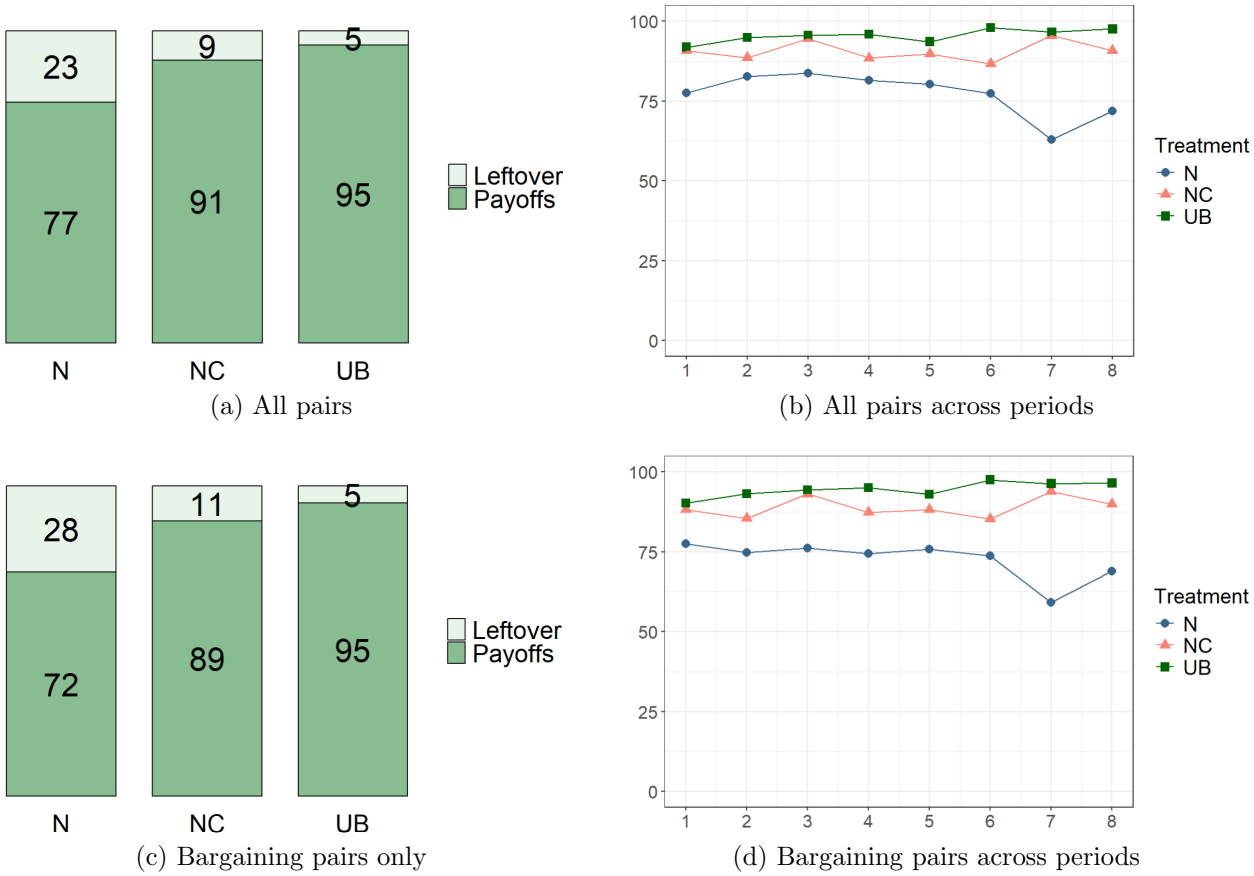
We examine the efficiency of the three negotiation environments by comparing their agreement rates, as shown in Figure 7. As hypothesized, unstructured bargaining exhibits the highest proportion of successful deals, reaching 100% in some periods. Between the two NDG treatments, communication also vastly improves the rate of compatible demands (those staying below the total M), aligning with the findings of Feltovich and Swierzbinski (2011). The efficiency ranking across treatments, with UB being the highest, followed by NC, and then N, is also consistent across periods. T-tests also confirm significant differences in agreement rates between three treatment pairs: N vs NC, N vs UB, and NC vs UB ($ps < 0.01$).



(a) Overall (b) Across periods

Figure 7: Percentages of bargaining success by treatment

Figure 8 further illustrates total payoffs (the sum of payoffs in each pair) as a proportion of the total pie M across treatments. The observed results are also consistent with the previous trend: subjects in the UB treatment receive the highest payoffs as a proportion of M at 95% on average (also at 95% for the subsample of bargaining pairs), followed by NC at 91% (89% for bargaining pairs) and N at 77% (72% for bargaining pairs). Significant differences in payoff rates are also identified in t-tests for three pairwise comparisons between treatments ($ps < 0.01$). Although the N treatment has fewer pairs that proceed to negotiation, its final payoffs remain significantly lower than the other two environments, primarily due to higher failure rates among bargaining pairs.



(a) All pairs

(b) All pairs across periods

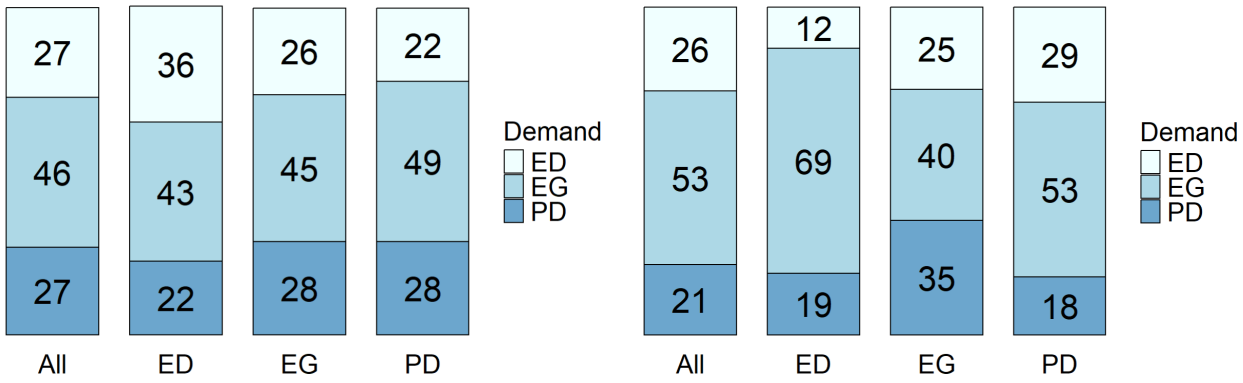
(c) Bargaining pairs only

(d) Bargaining pairs across periods

Figure 8: Sum of payoffs in each pair as a proportion of the total pie M by treatment

We further investigate individual demands in the NDG by identifying the closest projected allocation according to the three division norms, as depicted in Figure 9. Contrary to our hypothesis, demands most frequently approximate the equal-gain rule (46%), rather than the proportional division (27%). Among those who reach a deal in unstructured bargaining (Figure 10), the outcomes are also the closest to the equal-gain norm, averaging 52%. Binomial tests for both NDG demands and UB agreements further confirm significant differences between the proportion of each rule in bargaining outcomes and the 33.3% benchmark (all ps < 0.01, except for the PD rule in UB with $p = 0.04$). Furthermore, the EG dominance is consistent regardless of the norm subjects are initially attached to in both the NDG and unstructured bargaining. As a result, Hypotheses 3b and 3c are not supported by our data.

In addition, we examine the subsamples of pairs that initially share the same norm, as



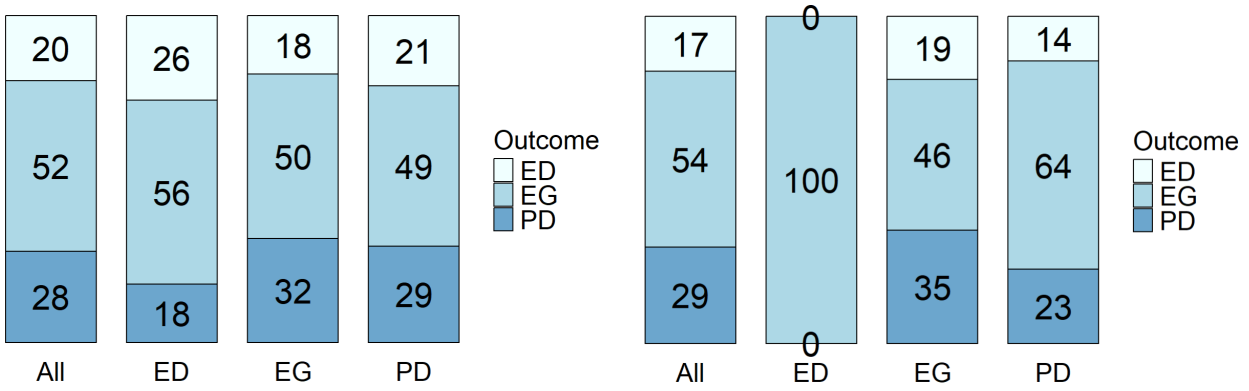
(a) All NDG subjects (b) Only subjects in pairs sharing the same norm

Figure 9: Percentages of the nearest norm's projections for NDG demands, across all subjects (left-most column) and by initial norm (remaining three columns). Note: Analysis is based on individual demands in the N and NC treatments. To identify the closest norm, we assign a value of 1 to a norm if its projection is closest to an NDG demand. When a demand is equally distant between two norms, we assign a value of 1/2 to each norm.

exhibited in Figure 9b for NDG and Figure 10b for unstructured bargaining. Demands and bargaining outcomes in both groups also align most closely with the equal-gain norm (53-54%). Notably, equal gain is less popular as the outcome for subjects initially following this norm (40% for NDG demands and 46% for UB allocations) than for those attached to other norms. In the NDG, 69% of ED followers and 53% of PD followers subsequently make demands close to equal gain. In unstructured bargaining, 64% of pairs that abandon the proportionality rule end up with agreements approximating equal gain. Lastly, only two pairs in the ED subsample of the UB treatment proceed to negotiation, and both reach deals approximating equal gain.

6.4 Exchanged messages

We analyze the exchanged texts in treatments NC and UB, which allow communication. Figure A.1 illustrates word frequency in the messages overall and within each of the two environments. With exclusion of formality words (such as "thank" or "please"), "rule" was by far the most mentioned term, followed by numbers representing proposed allocations. These observations reflect that the consideration for different division norms was not limited to



(a) All unstructured bargaining subjects

(b) Only subjects in pairs sharing the same norm

Figure 10: Percentages of the nearest norm's projections for unstructured bargaining payoffs, across all subjects (left-most column) and by initial norm (remaining three columns). Note: Analysis is based on individual payoffs (results of bargaining) of deals in the *UB* treatment. To identify the closest norm, we assign a value of 1 to a norm if its projection is closest to an individual payoff. When a payoff is equally distant between two norms, we assign a value of 1/2 to each norm. In the right panel, only two pairs sharing the *ED* norm engaged in bargaining and both ended up closest to *EG* projections.

the preselection stage at the beginning, but persisted throughout the experiment. Moreover, discussions about equality were also frequent during negotiation, as messages proposing a half-and-half (equal split) share were common. Besides, several subjects argued that the equal-gain rule seemed the most equitable of the three. When discussing a fair way to divide M, some participants also referenced their equal scores in the real-effort task as a reason to disregard the projected allocation, which they likely considered unfair.

7 Conclusion and discussion

We conduct a bilateral bargaining experiment, in which participants first select a preferred division rule from three principles: equal division (where both sides earn exactly half of the pie), equal gain (where both parties receive half of the joint surplus in addition to their initial holdings), and proportional division (where each party's payoff is proportional to their inputs). The initial holdings, which also serve as individual contributions to the shared pie and disagreement payoffs, must be earned through a real-effort task. When paired with

another sharing the same division norm, participants must decide whether to follow the allocations dictated by their chosen rules or negotiate for an alternative outcome. We explore three bargaining environments in our treatments, varying in the flexibility to coordinate proposals: the Nash Demand Game (NDG) with and without communication, as well as unstructured bargaining.

Overall, the initial selection of a preferred division norm seems to anchor decision making throughout the experiment. When matched with someone sharing the same norm, the majority of participants (74%) choose to adhere to their preselected rule. Even among subjects that proceed to bargaining, the significance of each norm remains impactful during negotiation, as reflected by the content of exchanged messages.

To address our central research question concerning the conditions that trigger norm abandonment, the primary answer appears to be the pro-self perception of (un)fairness. Bargaining is most frequently initiated by low contributors following proportional division, and high contributors attached to equal split. In both scenarios, the actor likely perceives their payoff projected by their norm as too low. With the lowest rate of abandonment, equal division exhibits the steadiest adherence among the three principles, whereas attachment to proportionality appears the weakest. In essence, these patterns suggest that adherence to equality is more robust than adherence to equity (proportionality), despite both being considered principal norms of fairness in resource division (Deutsch 1975; Albin 1993). Lastly, participants engage in negotiation more frequently when the settings allow greater freedom to coordinate demands through communication and proposal flexibility: more bargaining takes place in the NDG with communication and unstructured bargaining, compared to the most restrictive form of the NDG.

Among the three division norms, equal gain prevails as the most favored both during preselection and in bargaining outcomes. In the NDG, subjects most likely align their demands with equal-gain allocation, regardless of their initial norm choice. In unstructured

bargaining, pairs most frequently reach deals closest to equal-gain projections. This preference for equal gain might be connected to the concept of "stable entitlements" introduced by Kamijo (2022), as well as the compromise effect in bargaining proposed by Galeotti, Montero, and Poulsen (2022). In our design, this norm, which can be characterized as liberal equality, seems to represent a middle ground between the two ideological extremes, strict equality (equal division) and libertarianism (proportional division). In essence, equal gain embodies both equality and proportionality: the joint profit is divided equally, while individual contributions are returned exactly as they have been made, thus maintaining the original proportion. Beyond the inspiration from the framework of Nielsen and Rehbeck (2022), our design can also be linked to experiments focusing on decision-making behind the "veil of ignorance." When not aware of their position in the dictator game (or being "behind the veil"), individuals tend to select egalitarian divisions more frequently, due to risk aversion and social preferences (Frignani and Ponti 2012; Schildberg-Hörisch 2010). In our case, the popularity of the equal-gain rule in the initial selection stage might be attributed to its appearance as a more equal option than proportionality while still considering differences in inputs.

The relatively low prevalence of equal split in our results is consistent with previous studies that find this norm unpopular when bargainers must earn their positions through a real-effort task, leading to stronger attachment to the initial holdings (Gächter and Riedl 2005; Karagözoğlu and Riedl 2015; Feltovich 2019; Kamijo and Yokote 2022). On the other hand, our results do not confirm the prevalence of the proportional solution following joint production based on proportionality of individual inputs. To ensure subjects' awareness of pie-size generation based on input proportionality, we highlighted this fact in both instructions prior to norm selection (Part 1) and negotiation (Part 2). However, the selection of a preferred division norm at the beginning potentially shifted the focus of decision-making toward fairness consideration of the three norms, rather than how the shared pie was generated. Additionally, the difference between Takeuchi et al.'s (2022) observations and ours may arise from how the disagreement payoffs are determined. Bargainers' endowments in the former study are based on an overall

ranking and stay constant throughout different matchings. In our experiment, participants' initial holdings are determined from their task performance relative to their opponent: a subject's disagreement payoff and bargaining position might change according to whom they are paired with in each new round. Potentially, the relative endowments in our settings might result in a weaker sense of entitlement than the constant endowments in Takeuchi et al.'s (2022) study.

Building on the preceding comparison, future research could directly explore differences between relative entitlements (how much one should earn compared to others) and absolute entitlements (how much one should earn based on their individual contribution). Examining this distinction could be particularly meaningful, given the potential impact of entitlements on bargaining outcomes. Furthermore, researchers could adapt the experimental framework of Nielsen and Rehbeck (2022) to incorporate axiomatic qualities of bargaining solutions. For example, paired bargainers could first agree on certain principles, such as individual rationality or scale invariance, that should be featured in their bargaining outcomes. Subsequently, players receive feedback on deviations from their selected axioms in their bargaining agreements and must decide whether to adjust their deals. Lastly, beyond division norms, other social norms can be investigated in a similar experimental framework. For example, gender and ethnic differences seem to permeate bargaining, as evidenced in various bargaining behaviors (Castillo et al. 2013; Michelitch 2015; D'Exelle, Gutekunst, and Riedl 2023). Both laboratory and field experiments can be designed to identify factors that motivate abandonment of gender norms and intergroup bias in resource division, which can provide valuable insights for resolving social conflicts.

Our observed results of the three norms are reflected in various attempts to resolve the Israel-Palestine conflict. The 1947 United Nations Partition Plan proposed a roughly 50-50 land division between an Arab state and a Jewish state. This proposal was rejected by the Palestinian leadership, who deemed it unfair for the larger Arab population (Tessler

2009). This outcome aligns with our observation that the higher contributor is likely to reject an equal split of shared resources. Proportional division is evident in the water-sharing agreement of Mountain Aquifer. The 1995 Oslo II Accord referenced existing water usage patterns and allocated roughly 80% to Israel and 20% to Palestine. Following our finding that the lower contributor is more likely to reject a proportional division, the Oslo II allocation has been criticized as inequitable by Palestine and its supporters, and served as a major point of contention in the ongoing conflict (El-Fadel et al. 2001; Selby 2003). Lastly, elements of equal gain are present in the two-state solution, which emphasizes coexisting sovereignty and shared control of Jerusalem. The prevalence of equal gain in our results is reflected in the promotion of the two-state solution by key mediating parties, including the United Nations, the Arab League, the United States and the European Union, as the ultimate environment to achieve lasting peace and security (Kurtzer et al. 2012; Nimni 2020).

The prevalence of equal gain can also be found in various international conflict resolutions. The 1984 resolution to the Beagle Channel conflict awarded comparable gains to both sides: Chile retained sovereignty of the three disputed islands and access to Argentina's Le Maire Strait shipping route, while Argentina gained favorable maritime access and exclusive economic zones near the islands (Garrett 1985). Another prime example of equal gain is the 1998 Good Friday Agreement, which ended the decades-long conflict in Northern Ireland. The resolution ensured equitable representation in governance for both unionists and nationalists, balancing equality and proportionality in power-sharing (McGarry and O'Leary 2006). Cross-community voting represents an equal relationship between the two sides, as important decisions require majority support from both unionist and nationalist blocs. In addition, the distribution of seats in the Northern Ireland Assembly reflects the proportions of votes received by the parties, as evidenced by the recent shift of seats from unionists to nationalists due to changes in voting patterns (Kelly 2024).

Equal gain is also embraced in complex international conflicts involving multiple parties.

The 1959 Antarctic Treaty between 12 signatories exemplifies equal gain by suspending all territorial claims and military activities, while promoting joint research cooperation as the key to peaceful mutual usage of resources on the continent (Yao 2021). The 2005 agreement between China, the Philippines and Vietnam, which facilitated joint oil exploration in the disputed area in the South China Sea, stands as the only fruitful step toward peaceful coexistence to date, despite not withstanding the Philippines' political tensions in 2023 (CNOOC, PetroVietnam, and PNOC 2005; Gomez 2023). Overall, our experimental results and key elements of several international conflict resolutions underline the significance of the equal gain norm in reaching an agreeable outcome.

Data Availability Statement

The datasets generated during and/or analyzed during the current study are available in the Harvard Dataverse repository: https://doi.org/10.7910/DVN/BIKP4D.

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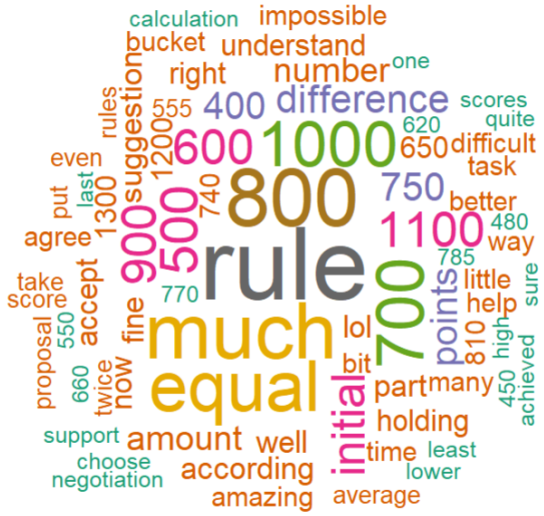
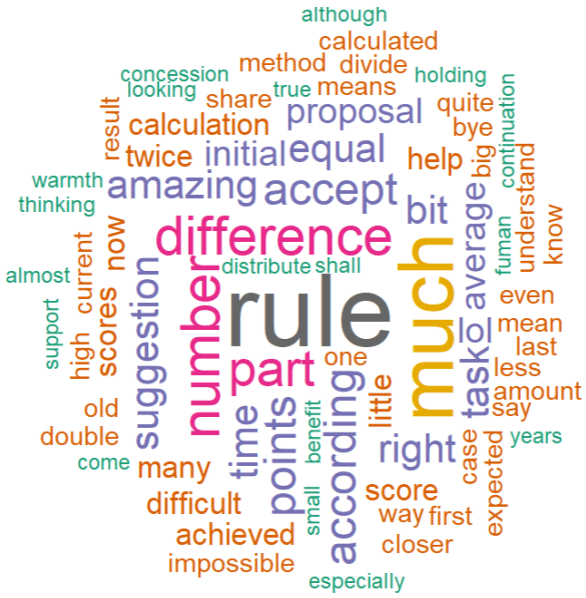
Appendix



(a) All messages

(b) All messages, excluding numbers

(c) Messages in *NC* treatment, excluding numbers



(d) Messages in *UB* treatment, excluding numbers

Figure A.1: Messages exchanged in treatments *NC* and *UB*. Notes: Words of formality, such as *please* and *thanks*, are excluded. The term *equal* also includes *equally*, *equality*, and *half* (when referring to dividing the pie half-half).