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TWO-PERSON BARGAINING MECHANISMS:

A LABORATORY EXPERIMENT^{*}

Damien Bol,[†] Jean-François Laslier[‡] and Matías Núñez[§]

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Abstract

We conduct a series of experiments in which two subjects bargain over five alternatives. Following an experimental design closely related to ?, we evaluate the performance of three bargaining mechanisms: (i) one subject shortlists a bloc of three alternatives before the other chooses one among them, (ii) both subjects veto alternatives simultaneously and in a bloc, and (iii) both subjects veto alternatives simultaneously and gradually one after the other. Our data show the following: The non-symmetric shortlisting mechanism (i) is highly efficient but exhibits an important first-mover advantage. The simultaneous mechanism (ii) is less efficient than (i) and generates high ex post inequality. The gradual veto mechanism (iii) is no less efficient than (i), but has the important advantage of shutting down the possibility of any first-mover advantage.

JEL Codes: C78; D7.

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1 Introduction

Situations in which two parties negotiate over a set of alternatives abound. Project evaluations, committee decisions, and the selection of arbitrators are few instances of the large

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variety of situations of bargaining between two parties. In legal settings, the standard bargaining situation involves two parties with (partially) opposing preferences.

The early literature on two-person bargaining has taken an axiomatic perspective. In most of these contributions, the “disagreement point” plays the important role of an exogenous threat (see Kalai and Rubinfeld, 1987), and even determines the distribution of a surplus. The same is true for the game-theoretical approach later initiated by Nash (1950). Further, the importance of the exogenous threat culminates in the prominent experimental approach of two-person bargaining, i.e., the ultimatum game (see Roth and Shalizi, 2009).

The recent literature let aside the question of participation and concentrates on the comparative properties of conflict resolution mechanisms used in practice.¹ One of the objectives is to design bargaining rules or mechanisms that maximize some welfare criteria. The theoretical results of Nash (1950) and Kalai and Rubinfeld (1987) on two-person bargaining indicate that an ideal mechanism certainly does not exist, making comparative and empirical investigations essential. Note that in reality institutions often impose structure on negotiations. For instance, in the US legal system, attorneys can reject some of the potential jurors of the jury trial through a variety of mechanisms. A debate emerged in the legal doctrine on the impact of these procedures on the jury composition (see Kalai and Rubinfeld, 1987). The methods used for the selection of arbitrators and their consequences at the individual and aggregate level have also been considered in the economics’ literature (see Roth and Shalizi, 2009). In such a setting, Kalai and Rubinfeld (1987) design a mechanism that works in two steps, and that we call the non-symmetric shortlisting mechanism.

- **Non-symmetric shortlisting mechanism:** In the first step, a subject vetoes n of the $2n + 1$ alternatives. In the second step, her opponent vetoes n out of the $n + 1$ remaining alternatives. The outcome is the only alternative that remains.

By definition, this mechanism is non-symmetric between the two subjects. The symmetry requirement, violated here, is an important concern in the bargaining literature. Symmetry (or “anonymity”) seems natural for defining a legally binding protocol, and one can also argue that the absence of symmetry makes the model incomplete: if symmetry is broken it must have been broken in one way or the other (for instance randomly) and the way it is broken should be part of the model. However, Kalai and Rubinfeld (1987) convincingly argue that the Non-symmetric

¹Note that we are implicitly referring to the literature on structured bargaining, where bargaining occurs following some predetermined steps (see Roth and Shalizi, 2009 for the distinction between structured and unstructured bargaining). Yet, there is also an experimental literature on unstructured free-form bargaining. For instance, Roth and Shalizi (2009) focuses on efficiency and equity. They observe that many bargaining outcomes are Pareto efficient and document the existence of a compromise effect, i.e., that subjects tend to select equal-earnings outcomes.

shortlisting mechanism is well-understood in the lab (this finding was later confirmed by ?), and an empirical evaluation of it should concentrate on what results a mechanism produces.

We contribute to this empirical evaluation of two-player bargaining mechanisms by adopting an experimental design very close to the one in ?, where players are matched by pairs and know each other's preferences. They need to select an alternative following the rules of a mechanism. We consider three mechanisms: the previously mentioned non-symmetric shortlisting mechanism and two symmetric variants: the simultaneous veto mechanism of ? and an original gradual vetoes mechanism.

- **Simultaneous veto mechanism:** simultaneously, each subject vetoes n alternatives out of the $2n + 1$ available ones and the outcome is a uniform lottery over non-vetoed alternatives.

- **Gradual vetoes mechanism:** at each step and simultaneously, each subject vetoes one alternative. This procedure goes on until either one or no alternative is left. If one alternative is left, this alternative is the outcome. If no alternative is left, precisely two alternatives were removed at the previous step, and the outcome, in this case, is a lottery over these two.

We compare these mechanisms in a series of profiles that exhibit different degrees of disagreement over five alternatives. The profiles are labelled A0, A2, A3, and A5. A0 exhibits full disagreement, i.e., subjects' preferences over alternatives are fully opposed, whereas A5 depicts full agreement, i.e., subjects' preferences over the alternatives are identical. Profiles A2 and A3 are intermediate, i.e., subjects agree over their worst alternatives but have opposed preferences over their most preferred ones. In A2 the subjects agree over their worst two alternatives and in A3 they agree over their worst three alternatives.

We experimentally evaluate whether the three mechanisms induce high levels of ex-post satisfaction, measured over five dimensions. We first consider standard measures of aggregate welfare: (i) the (utilitarian) efficiency of the outcome and (ii) the inequality that it generates, combined with (iii) the magnitude of the first-mover advantage. We also explore the propensity of each mechanism to select (iv) consensual alternatives and (v) Pareto efficient ones.

Our results show that the non-symmetric shortlisting and gradual vetoes mechanisms outperform the simultaneous one regarding measures (i) and (ii), and (iii). Moreover, the level of inequality generated by the gradual vetoes mechanism is lower than or equal to the one generated by the non-symmetric shortlisting mechanism depending on the profile. We also document the existence of a first-mover advantage in the non-symmetric mechanism,

both in ?'s data and in our own. Indeed, the order of play matters in this mechanism. To understand this, one can think of the non-symmetric shortlisting mechanism as a generalized version of the ultimatum game where the first mover makes an offer and the second subject chooses the offer (in our setting, without exogenous outside option in our setting). It is a well-documented that the first mover obtains a larger payoff than the second mover. The same occurs in our setting.

Measures (iv) and (v) suppose that a subject's utility is measured by her monetary payoff. An alternative is thus Pareto-efficient when there is no other alternative preferred by both subjects. As our data show, the three mechanisms under consideration achieve high levels of Pareto-efficiency, with some differences depending on the preference profile. Further, we define a consensual alternative as one that gives the highest possible level of utility to the worse-off subject. For instance, if some alternative a is unanimously preferred, a is the only consensual alternative. If, by contrast, a and b are the top two alternatives of each subject but neither is unanimously preferred, both a and b qualify as consensual.² Note that a consensual alternative is necessarily Pareto-efficient but the contrary need not be the case. Regarding the frequency of consensual alternatives, both the non-symmetric shortlisting and gradual vetoes mechanisms outperform the simultaneous veto one.

As a final remark, one should note that by definition the simultaneous veto mechanism works in one step only and the non-symmetric shortlisting one in two steps. In our five-alternative profiles, the gradual veto mechanism required between 2 and 3 steps on average.³ With more alternatives, the distinction between the gradual mechanism and the others would probably be stronger.

The rest of the paper is organized as follows. After briefly reviewing the literature, we lay down the model and the mechanisms. We then analyze the aggregate experimental results under the different mechanisms, and we end by considering individual behavior in the lab.

2 Review of the literature

The literature on mechanism design is concerned with the design of procedures that achieve efficient outcomes while giving guarantees players to be treated fairly, i.e., the functioning

²This rule has been considered in the literature under different names: for instance the Rawlsian arbitration rule in ?, the Kant-Rawls social compromise in ?, the Fallback bargaining in ? and the Unanimity Compromise in ?.

³It takes at least two rounds to reach an alternative. In our data, 63% of all games finish after two rounds, 96% finish after a third round, and 100% finished after a fourth round.

of the bargaining does not harm some players more than others. Yet, the literature on implementation theory underlines that such design is far from trivial. As shown by both ? and ?, one cannot design simultaneous deterministic mechanisms that deliver exclusively Pareto optimal alternatives at any Nash equilibrium when preferences are unrestricted.⁴ To circumvent such difficulty, the literature proposes to focus on dynamic games that involves several stages or steps or on mechanisms involving lotteries, i.e. those allowing randomization. In both instances, the implementation becomes more permissive, which means that Pareto-efficient outcomes then exist in equilibrium. The key that bring together the previously mentioned mechanisms is the idea of vetoes. ? considers the “VAOV” mechanism where players offer an alternative to the opponent that needs to validate the veto. Yet, this protocol involves many stages and subgame perfection becomes a bad predictor of actual experimental behavior. ? propose a two-stage game where the first subject vetoes half of the alternatives and the second one vetoes all but one of the remaining ones. ? design sequential games that select the consensual alternative preferred by the first mover. Finally, ? design simultaneous mechanisms where each player vetoes a list of alternatives and the outcome is randomly picked among the non-vetoed alternatives.

3 Theoretical setting

Two players, denoted by $i = 1, 2$, bargain over a finite set of alternatives A . The monetary payoff of player i associated to alternative $a \in A$ equals $u_i(a) \in \mathbb{R}$. We assume that no player is indifferent between two alternatives so that $u_i(a) \neq u_i(b)$ for any distinct alternatives $a \neq b$. We let $u = (u_1, u_2)$ denote the profile of monetary payoffs. For each alternative a and each player i , $l(a, u_i)$ denotes the number of alternatives less preferred than a for player i . Since we focus on legal settings, where both parties are given detailed information over the potential alternatives, it makes sense to assume that u is common knowledge.

The set $\text{po}(u) = \{x \in A \mid \nexists y \text{ s.t. } u_i(y) > u_i(x) \text{ for } i = 1, 2\}$ contains the Pareto optimal alternatives at u . An alternative x is consensual when the less satisfied player with x is (weakly) better-off than the less satisfied player with any other alternative.⁵ Hence, the set of con-

⁴The impossibility result can also be stated as “No Pareto efficient social choice rule is Nash implementable when the domain of preferences is unrestricted.” ? and ? independently characterize the set of social choice rules that can be Nash implemented with two players and show that suitable domain restrictions (especially in the Euclidean space) can overcome this powerful negative result. In this sense, our contribution also speaks to the literature on partial honesty (see ?) and the one on King Solomon’s dilemma (see ?).

⁵This is sometimes referred to as the “Rawlsian notion of consensus”.

sensual alternatives at u is defined by $\text{cons}(u) = \arg \max_{x \in A} \min_{i=1,2} u_i(x)$. Remark that any consensual alternative is Pareto optimal. Moreover, any profile admits one consensual alternative while there might be two of them for some preference profiles.

Observe that we focus on mechanisms that are ordinal in nature so that the outcome does not depend on the precise values of u_i but simply on the ordinal preferences over the alternatives. For convenience, we introduce the following notation: for each player i , we let \succ_i denote her ordinal preferences over the alternatives with $u_i(a) > u_i(b) \iff a \succ_i b$ and we let $\succ = (\succ_1, \succ_2)$ be the ordinal preference profile.

4 Mechanisms

As discussed in the introduction, we study three different mechanisms using vetoes: the non-symmetric shortlisting (ψ), simultaneous (θ), and gradual vetoes (g) mechanisms. **For the sake of simplicity, we assume that there is an odd number of alternatives, i.e. $\#A = 2k+1$, but the different mechanisms can be adapted when there is an even number.**

4.1 Non-symmetric shortlisting mechanism

We let \mathcal{A}^k denote the set of subsets of A consisting of exactly k alternatives. The non-symmetric shortlisting mechanism $\psi : \mathcal{A}^k \times \mathcal{A}^k \rightarrow A$ requires that the first mover, denoted player i , announces a list ℓ_i of k vetoed alternatives and then the second mover, player j with $j \neq i$, announces a list ℓ_2 of k vetoed alternatives among the non-vetoed ones. The outcome $\psi(\ell_1, \ell_2) = A \setminus (\ell_1 \cup \ell_2)$ is the unique alternative that remains non-vetoed after the players' vetoes. As shown by ?, for each preference profile u , this mechanism admits a unique subgame perfect equilibrium outcome.

The following strategies always constitute an equilibrium:

- ℓ_1 : Player 1 vetoes her worst k alternatives in the top $k+1$ alternatives of player 2,
- ℓ_2 : Player 2 vetoes her worst k alternatives in $A \setminus \ell_1$.

The equilibrium outcome (unique for all equilibria), which we denote $o_{1,2}(u)$, is the alternative selected at equilibrium when 1 moves first and 2 moves second:

$$o_{1,2}(u) = \max_{u_1} \overbrace{\{a \in A \mid l(a, u_2) \geq k\}}^{\text{Best alternative for Player 1}}. \quad (1)$$

Not among the worst k for Player 2

In other words, $o_{1,2}(u)$ represents the most preferred alternative of Player 1 over the $k + 1$ most preferred ones of Player 2. Similarly, when Player 2 moves first, the outcome equals $o_{2,1}(u)$, the most preferred alternative of Player 2 over the $k + 1$ most preferred ones of Player 1.⁶ For some preference profile u , neither $o_{1,2}(u)$ nor $o_{2,1}(u)$ are consensual alternatives (see, e.g., the profile A2 below).

4.2 Simultaneous mechanism

The simultaneous mechanism $\theta : \mathcal{A}^k \times \mathcal{A}^k \rightarrow \Delta$ requires that, simultaneously, each player i announces a list ℓ_i of k vetoed alternatives. It follows that any alternative in ℓ_1 and ℓ_2 is vetoed. The outcome $\theta(\ell_1, \ell_2) = \text{uni}(A \setminus (\ell_1 \cup \ell_2))$ is a uniform lottery over the non-vetoed alternatives.⁷ When the two players veto disjoint sets of alternatives (i.e. $\ell_1 \cup \ell_2 = \emptyset$), the mechanism selects the alternative x which is the unique non-vetoed one (i.e. $x = A \setminus (\ell_1 \cup \ell_2)$).

Under mild assumptions concerning the extension of preferences to lotteries, this game admits a pure-strategy equilibrium for each preference profile u .⁸ The game in general admits several equilibria, but at each equilibrium, a unique alternative is selected and this alternative is Pareto efficient. The set of pure-equilibrium outcomes coincides with the set $\text{pv}(u)$, the Pareto-and-veto rule whose definition is as follows:

$$\text{pv}(u) = \underbrace{\text{po}(u)}_{\text{Pareto optimal alternatives}} \cap \underbrace{\{a \in A \mid l(a, u_1) \geq k\}}_{\text{Not among the worst } k \text{ for Player 1}} \cap \underbrace{\{a \in A \mid l(a, u_2) \geq k\}}_{\text{Not among the worst } k \text{ for Player 2}} . \quad (2)$$

In other words, the simultaneous mechanism selects the Pareto efficient alternatives that are not among the k least preferred alternatives of any of the players. For each $x \in \text{pv}(u)$, any pair (ℓ_1, ℓ_2) with the following properties constitutes an equilibrium selecting x :

- ℓ_1 vetoes k alternatives less preferred than x for 1,
- ℓ_2 vetoes k alternatives less preferred than x for 2 and
- $\ell_1 \cap \ell_2 = \emptyset$.

It can be shown that any consensual alternative is an equilibrium outcome, so that for each u , $\text{cons}(u) \subseteq \text{pv}(u)$. The reason for this is that any consensual alternative is Pareto effi-

⁶If one randomizes the identity of the first mover, the set of subgame-perfect equilibria outcomes for each preference profile u equals $o_{1,2}(u) \cup o_{2,1}(u)$. This guarantees ex-ante fairness but no ex-post fairness. In this paper, we focus on ex-post fairness.

⁷For any set $X \subseteq A$, $\text{uni}(X)$ is the uniform lottery over elements in X . A uniform lottery is defined as follows: for each $X \subseteq A$, $\text{unif}(X)$ is the lottery such that $\text{uni}(X)_i = \frac{1}{\#X}$ if $i \in X$ and $\text{uni}(X)_i = 0$ if $i \notin X$.

⁸See ? for a precise analysis; stochastic dominance suffices to prove this claim.

cient. To see why it is never among the worst k alternatives for each player, it suffices to note that for each preference profile, there is some alternative that is ranked among the top $k + 1$ alternatives or better by both players (see ? for a precise analysis of the "depth" of the consensual alternatives, that is the minimal ranking that players associate consensual alternatives with).

4.3 Gradual vetoes mechanism

In the gradual vetoes mechanism, players simultaneously veto alternatives until one or none is left. This takes several steps. More precisely, at each step, both players (simultaneously) veto an alternative. If exactly one alternative remains, this alternative is the outcome. If all alternatives have been vetoed, this means that exactly two alternatives were non-vetoed at the previous stage and that both were vetoed, the outcome is a random draw over these two alternatives. This process is repeated until an outcome emerges.

For the sake of precision, we introduce its formal definition. For each player i and each step t , we denote by v_i^t the alternative vetoed by player i at step t and by $v^t = \{v_1^t, v_2^t\}$ the set of vetoed alternatives at stage t . The set A^t contains the non-vetoed alternatives at the beginning of step t . It is defined in a recursive manner: letting $A^1 = A$, we have $A^t = A^{t-1} \setminus v^{t-1}$ for each $t \geq 2$.

The rules of the mechanism are as follows:

- At any step t :
 - a. If $\#A^t \geq 2$, then each player $i = 1, 2$ announces v_i^t in A^t .
 - b. If $A^t = \{x\}$, x is the outcome.
 - c. If $A^t = \emptyset$, then $A^{t-1} = v^{t-1} = \{x, y\}$ for some $x, y \in A$ with $x \neq y$. The outcome is $\text{uni}(x, y)$, a uniform lottery over the two vetoed alternatives in stage $t - 1$.

Observe that the number of steps is endogenous; in our experimental setting with 5 alternatives, it can vary from 3 (when the players veto disjoint alternatives in steps 1 and 2) to 5 steps (where both players veto the same alternative in steps 1 to 4). While the set of subgame-perfect equilibria outcomes is large, it can be shown that it never contains an element among the worst two elements of a player. Moreover, the next remark and proposition underline two properties of the subgame perfect equilibrium outcomes.

Remark: The gradual vetoes mechanism may lead to Pareto-dominated alternatives in a

subgame perfect equilibrium.

To see why, consider the following preference profile $\succ = (\succ_1, \succ_2)$ with $a \succ_1 b \succ_1 c \succ_1 d \succ_1 e$ and $a \succ_2 b \succ_2 c \succ_2 d \succ_2 e$. The unique consensual alternative is a . Consider the following strategy profile:

1. Step 1: Voter i vetoes a
2. For any $t \geq 1$ step t : Voter i vetoes his least preferred alternative in A^t

This strategy profile leads to b . Given that the opponent vetoes a in the first step, the best possible outcome that a player can reach is b . It is hence a subgame perfect equilibrium. Yet, this equilibrium requires that both players veto their most preferred alternative, a highly unlikely situation in an experimental setting.

Imposing this behavioral restriction leads us to prove our formal result on the gradual vetoes mechanism (see the appendix A for a proof).

Proposition 1. *In the profiles used in the experiment, any subgame perfect equilibrium of the gradual vetoes mechanism selects a consensual alternative and, for any consensual alternative, there is an equilibrium that implements it.*

5 Experimental design

We conducted experiments between June 2019 and October 2020 in the PSE and CREST experimental labs.⁹ In each session, 20 subjects play 40 games. In each game, each subject is paired with another one. They can earn some money depending on their decisions and the decision of the subject with whom they are paired. At the end of the 40 games, the computer selects 10 games randomly, and the subjects receive the sum of their gains in these games. The experiment was computerized using zTree (?).¹⁰

In our experimental sessions, we tested the mechanisms described above: the *non-symmetric shortlisting mechanism*, the *simultaneous mechanism*, and the *gradual vetoes mechanism*. For the sake of simplicity, each session was based on a single mechanism. It is thus a between-subject

⁹To avoid any lab effect, we reproduce the entire analysis in restricting the sample to data coming from the lab in which we covered all: CREST. The results are remarkably similar, see appendix F.

¹⁰The full instructions as presented to subjects at the beginning of the experiment are in the supplementary material. After reading instructions and before starting the experiment, we let subjects answer a quiz about the rules in order to facilitate their understanding. The quiz questions are also available in the supplementary material.

design. We feared that confronting subjects with multiple mechanisms would confuse them. For each mechanism, we ran three sessions. Given that there are 20 subjects (and so 10 pairs of subjects) and 40 games, there are 400 games per session. A priori, we should thus have 1,200 observations for each mechanism. Yet, for one session in the simultaneous mechanism and another one in the non-symmetric shortlisting mechanism, there were only 16 subjects and thus eight pairs. The data points for these mechanisms are then 1,120 each. Likewise, there were only 18 subjects and 9 pairs in the three sessions with the gradual vetoes mechanism, so there are 1,080 data points for this last mechanism.

In each game, the subjects need to select an option among five available options. In the non-symmetric shortlisting mechanism, one subject in each pair is the first mover. This first mover selects three out of five options. The second mover then selects one option in this shortlist. In the simultaneous mechanism, both subjects select at the same time three out of five options. If there is only one option in common, this option is selected. If there are several, the computer breaks the tie by randomly selecting one option among the tied ones. In the gradual vetoes mechanism, the subjects simultaneously remove one option. Then, after observing the remaining options, each of them removes again one option simultaneously. These "rounds of elimination" are organized until only one option remains. In case the two last options are removed at the same time, the computer breaks the tie randomly in selecting one of the two tied options.

To give the possibility to subjects to coordinate and learn, we let them play several games together before reshuffling the pairs. In particular, we organized five repetitions of the same game with the same two subjects. Then, the pairs were randomly reshuffled and there are five more repetitions of the same game. After this, the preference profile changed, and it started again with 2×5 repetitions.

The experiment was run over four preference profiles. We used four preference profiles in our experiment, which exhibit an increasing degree of agreement among the voters. For the sake of clarity, we denote them as follows:

A0: The preferences of subjects are exactly opposed, the level of agreement is 0.

A2: Both subjects agree on the two worst options (d, e) and have opposed preferences on the others

A3: Both subjects agree on the three worst options (c, d, e) and have opposed preferences on the others

A5: Both subjects fully agree about all five options.

Table ?? presents the four preference profiles which we consider in the experiment. We indicate with a "*" the alternatives that are Pareto-efficient (for instance, all the alternatives are Pareto-efficient in A0). Moreover, we write in bold the consensual alternatives. For instance, c is the unique consensual alternative in A0 whereas a and b are both consensual in A2.

The monetary payoff associated with an alternative depends on its rank in the subject's preference. As shown in Table ??, the alternative ranked first gives the subject a payoff of €20 whereas the alternative ranked fourth is associated with €5. The order in which the subjects play with these preference profiles varies by session, but are identical for all three mechanisms. In all of them, we start with profile A5 (full agreement). Since this profile is straightforward in terms of theoretical predictions, we see it as a way for subjects to familiarize themselves with the experimental design. Then, the order is A2, A3, A0 in a session, A3, A0, A2 in another one, and finally A0, A2, A3.

Table 1: Preference profiles and monetary payoffs.

A0		A2		A3		A5		Monetary payoff
1	2	1	2	1	2	1	2	
a^*	e^*	a^*	c^*	a^*	b^*	a^*	a^*	€20
b^*	d^*	b^*	b^*	b^*	a^*	b	b	€15
c^*	c^*	c^*	a^*	c	c	c	c	€10
d^*	b^*	d	d	d	d	d	d	€5
e^*	a^*	e	e	e	e	e	e	€0

For the sake of clarity, Table ?? shows, for each profile, the different theoretical predictions for the non-symmetric shortlisting mechanism (denoted $o_{1,2}$ and $o_{2,1}$) and for the simultaneous mechanism (denoted rv) as well as the consensual alternatives (denoted $cons$). The last row of Table ?? shows the utility associated with the alternative that maximizes efficiency (that is the sum of payoffs).

Table 2: Consensual alternatives and equilibrium predictions.

	A0	A2	A3	A5
$O_{1,2}(\cdot)$	c	a	a	a
$O_{2,1}(\cdot)$	c	c	b	a
$PV(\cdot)$	c	b	a, b, c	a
$CONS(\cdot)$	c	b	a, b	a
maximal sum of payoffs	€ 20	€ 30	€ 35	€ 40

6 Aggregate results with the non-symmetric shortlisting mechanism

We first present the experimental results regarding the non-symmetric shortlisting mechanism. We report results from our experiment, as well as a re-analysis of those from ? who use a similar experimental design at the exception of a single preference profile¹¹.

As argued in the introduction, we focus on several measures to understand the outcome of each game. For each outcome x , we define its efficiency by $u_1(x) + u_2(x)$, that is the sum of monetary payoffs of subjects 1 and 2, and its inequality by $|u_1(x) - u_2(x)|$, the absolute value of the payoff difference between subjects. We also define the first-mover advantage, measured for each outcome x as $u_1(x) - u_2(x)$, the payoff difference between the first and the second mover. The inequality measures how different the payoffs are between the two subjects whereas the first-mover advantage measures the difference in favor of the subject playing first.

Table ?? presents data from a benchmark (i.e., random selection), from ?, and from our data. The benchmark is simply a simulation of the measures if an option was selected randomly. We observe that the non-symmetric shortlisting mechanism is close to select the most efficient outcome (see Table ?? for the maximal sum of payoffs at each profile). The main shortcoming of this mechanism seems to be related to the difference between the subjects' payoffs. First, we see that inequalities are positive and statistically significant compared of the benchmark in each profile. They range from 2.5 to 7.83, except in A5 where the subjects' preferences are identical and hence inequality is necessarily 0.

¹¹This additional profile, to which we refer as Pf5 is equal to $(a \succ_1 b \succ_1 c \succ_1 d \succ_1 e)$ vs $(e \succ_2 c \succ_2 a \succ_2 b \succ_2 d)$. Note that we also standardized the payoff from 0 to 20 in their data to make their results comparable to ours. In their experiment, stage payoffs range from 0 to 1 with a scale of 0.25 whereas our stage payoffs range from 0 to 20 with a scale of 5. In both experiments, the monetary payoff that a subject associates an alternative to only depends on its ranking in the profile.

Table 3: Non-symmetric shortlisting mechanism: efficiency and inequality.

	Benchmark (random selection)			De Clippel et al. [2014]			Our data		
	Efficiency	Inequality	First-mover	Efficiency	Inequality	First-mover	Efficiency	Inequality	First-mover
A0	20.00	12.00	0.00	20.00 (.)	2.50 (0.00)	-1.18 (0.00)	20.00 (.)	2.50 (0.00)	-0.43 (0.25)
A2	20.00	2.00	0.00	27.78 (0.00)	6.11 (0.00)	3.43 (0.00)	27.39 (0.00)	2.79 (0.00)	-0.14 (0.65)
A3	20.00	4.00	0.00	34.42 (0.00)	4.85 (0.00)	2.76 (0.00)	30.45 (0.00)	3.80 (0.00)	0.95 (0.00)
A5	20.00	0.00	0.00				38.04 (0.00)	0.00 (.)	0.00 (.)
Pf5	20.00	10.00	0.00	26.03 (0.00)	7.83 (0.00)	3.14 (0.00)			

Note: Entries are means. The benchmark is calculated from an average of random selections. In parentheses are p-values of t-tests testing equality between means of benchmark vs. means of ?/our data (two-tailed). Pf5 is $(a >_1 b >_1 c >_1 d >_1 e)$ vs $(e >_2 c >_2 a >_2 b >_2 d)$. N per cell=440 (?); 280 (Our data).

The data from ? also show that the first mover gains on average between two and three times more than the second mover in most profiles (statistically significant at $p < 0.01$ compared to the benchmark). This is a substantial advantage given that the average payoff in their experiment is 13.52 (with a standard deviation of 4.77). A first-mover advantage also appears in our experimental data show. For example, in profiles A2 and A3, the difference in payoffs between the first and second mover is around 0.14 and 0.18, for an average payoff of 14, and a standard deviation of 5. Although small this difference is still statistically significant ($p < 0.01$).

Note however that the first-mover advantage is absent in some profiles, especially in our experimental data. In profile A0, in which both subjects have opposed preferences, we even observe a negative (and statistically significant compared to benchmark) first-mover advantage. We interpret this as an effect of subjects having other-regarding preferences like equity.¹² Note, however, that the very possibility of the existence of a first-mover advantage (or disadvantage) justifies the search for symmetric mechanism¹³.

We now focus on Pareto efficiency and consensus. Recall, as argued in the theoretical analysis, that the outcome reached by subgame perfection in any profile corresponds to the most preferred alternative of the first mover over the three most preferred ones of the second

¹²See ? section D for a discussion on the role of other-regarding preferences in their data.

¹³Furthermore, we report in appendix B the evolution of the first-mover advantage as the experiments advance. We find that the difference in payoffs between the first and second subject increases when subjects get used to the experiment. In A2 for example (conflicting preferences over the three first options), it goes from 0.15 during the first 20 rounds of the experiment to 0.20 during the last 20 rounds

mover. This alternative is Pareto efficient but need not be consensual. Both hypotheses seem to be validated in the data: selected alternatives tend to be Pareto-efficient but might fail to be consensual.

More precisely, regarding Pareto efficiency, Table ?? indicates that in the vast majority of observations, the selected alternative is Pareto efficient. This is rather clear in the data collected by ?, in which such options are selected about 90% of the time. We also find this pattern in our replication data, although the rate of selection of Pareto efficient options is smaller, especially in A2. Yet, even in this profile, the pairs of subjects manage to reach a Pareto-efficient option, i.e., either a or b , 76% of the time.

Table 4: Non-symmetric shortlisting: Rates of Pareto-efficient and consensual options

	Benchmark (random selection)		De Clippel et al. [2014]		Our data	
	Pareto	Consensus	Pareto	Consensus	Pareto	Consensus
A0	100%	20%	100%	82%	100%	82%
			(.)	(0.00)	(.)	(0.00)
A2	60%	20%	89%	28%	88%	60%
			(0.00)	(0.00)	(0.00)	(0.00)
A3	40%	40%	97%	97%	76%	76%
			(0.00)	(0.00)	(0.00)	(0.00)
A5	20%	20%			91%	91%
					(0.00)	(0.00)
Pf5	40%	40%	90%	90%		
			(0.00)	(0.00)		

Note: Entries are proportions. The benchmark is calculated from an average of random selections. In parentheses are p-values of t-tests testing equality between proportions of benchmark vs. proportions of ?/our data (two-tailed). Profile 5 is ($a \succ_1 b \succ_1 c \succ_1 d \succ_1 e$) vs ($e \succ_2 c \succ_2 a \succ_2 b \succ_2 d$). N per cell=440 (?), 280 for our data.

Moreover, Table ?? reveals that the non-symmetric shortlisting mechanism often fails to select a consensual option and that the frequency with which this failure occurs depends on the profile. In A0, for instance, in which subjects have conflicting preferences over all five options, subjects coordinate over c “only” 82% of the time. Most worrying, in A2, in which subjects agree over their worst two options, subjects coordinate over c only 28% of the time (? data) or 60% of the time (our experimental data)¹⁴.

¹⁴We attribute the differences between the results in the data of ? and our replication data to the sample. ? conducted their experiment with a sample of undergraduate students in economics and social sciences, whereas we conducted ours with a more diverse sample in which students do not represent a majority of subjects. Evidence shows that students tend to be less generous than non-students, while not particularly better at coordinating (see ?, ?, ? and ? among others).

7 Aggregate results with alternative mechanisms

We now evaluate the performance of the alternative mechanisms in our data¹⁵ starting with efficiency and inequality. All profiles merged, the efficiency variable has a mean of 28.65 (with a standard deviation of 9.20) and the inequality one has a mean of 2.24 (with a standard deviation of 4.04). Table ?? shows the poor performance of the simultaneous mechanism compared to the non-symmetric shortlisting one. In some profiles, both achieve similar efficiency levels, but the efficiency associated with the former is statistically significantly ($p < 0.10$) and substantially smaller (by 1 or 3 points, i.e., 30% of the standard deviation). By contrast, the gradual vetoes mechanism is as efficient as the non-symmetric shortlisting one. The differences in means are not statistically different under most profiles, and when it is (A5), it is because it is more efficient than the non-symmetric shortlisting one, by 1.48 (i.e, 16% of the standard deviation). Inequality follows the same trend: it is generally higher with the simultaneous mechanism (by 0.5 or 1 point, i.e., 20% of the standard deviation), and this difference is statistically significant ($p < 0.01$) in many instances.

By contrast, the gradual vetoes mechanism is not more unequal than the non-symmetric shortlisting one. The only profile for which inequality is statistically significantly different ($p < 0.01$) between the two is A3, but the difference is in favor of the gradual vetoes mechanism: -2.53 (i.e. 63% of the standard deviation). Furthermore, it is important to remember that, although the non-symmetric shortlisting mechanism is not more unequal than the gradual vetoes one under most profiles, it still gives an advantage to the first mover in several profiles (see Table ?? above), which indicates that a clear difference between the two is the asymmetry between subjects induced by the order in which subjects play in the non-symmetric shortlisting mechanism.¹⁶

Table ?? also shows that the simultaneous mechanism does not perform as well as the non-symmetric shortlisting one when it comes to the rate of Pareto efficient and consensual outcomes. In A2 and A5, the rate at which a Pareto-efficient or consensual option is selected drops by 10 or even 20% points compared to the non-symmetric shortlisting mechanism (statistically significant at $p < 0.01$). In these profiles, it is difficult for subjects playing simultaneously to coordinate on who is going to remove the Pareto-dominated options and

¹⁵The detail of the results can be found in appendix C.

¹⁶We also present the (absence of) first-mover advantage under the alternative mechanisms in appendix D. This is not surprising given that which subject "plays first" is purely artificial in these symmetric mechanisms in which all subjects play at the same time.

Table 5: Comparison of mechanisms: efficiency and inequality.

	Shortlisting		Simultaneous		Gradual	
	Efficiency	Inequality	Efficiency	Inequality	Efficiency	Inequality
A0	20.00	2.50	20.00 (.)	3.07 (0.25)	20.00 (.) (.)	3.04 (0.27) (0.95)
A2	27.39	2.78	28.18 (0.17)	3.57 (0.05)	27.00 (0.55) (0.06)	1.30 (0.00) (0.00)
A3	30.45	3.80	28.37 (0.01)	3.23 (0.00)	29.74 (0.35) (0.09)	3.59 (0.26) (0.07)
A5	38.04	0.00	35.18 (0.00)	0.00 (.)	39.52 (0.00) (0.00)	0.00 (.) (.)

Note: Entries are means. In parentheses are p-values of t-tests testing the equality of means between shortlisting vs. simultaneous/gradual (first row of parentheses) and between simultaneous vs. gradual (second row of parentheses) (two-tailed). N per cell = 280 (shortlisting and simultaneous), 270 (gradual).

select the Pareto-efficient and consensual options, that is a or b (see below for a detailed analysis of the strategies adopted by subjects).

The gradual vetoes mechanism performs better. The rates at which Pareto-efficient and consensual options are selected approach those of the non-symmetric shortlisting mechanism. The difference in rates is never larger than 7% points and not statistically significant at a level of $p < 0.01$, except in A2 and A5 in which the gradual vetoes mechanism performs even better than the non-symmetric shortlisting one. This is for example the case in A2, in which the subjects have conflicting preferences over the three first options. The rate at which the consensual option (b) is selected increases by 13% points (statistically significant at $p < 0.01$).

An important issue with these alternative mechanisms is that they can lead to ties, i.e., that is the selection by subjects of several options. In our experiment, these ties are broken by a lottery in which the computer selects an option randomly among the tied alternatives. Ties need not be a bad outcome, their adequacy depends on the profile. For instance, in A3, one may argue that the ideal outcome rejects the three Pareto-dominated alternatives c, d, e but uses a fair lottery on the a and b . However, in the unanimous profile (A5) a tie is obviously a bad result.

Table 6: Comparison of mechanisms: efficiency and inequality.

	Simultaneous		Gradual	
	Efficiency	Inequality	Efficiency	Inequality
A0	20.00 (.)	3.07 (0.25)	20.00 (.) (.)	3.04 (0.27) (0.95)
A2	28.18 (0.17)	3.57 (0.05)	27.00 (0.55) (0.06)	1.30 (0.00) (0.00)
A3	28.37 (0.01)	3.23 (0.00)	29.74 (0.35) (0.09)	3.59 (0.26) (0.07)
A5	35.18 (0.00)	0.00 (.)	39.52 (0.00) (0.00)	0.00 (.) (.)

Note: Entries are means. In parentheses are p-values of t-tests testing the equality of means between shortlisting vs. simultaneous/gradual (first row of parentheses) and between simultaneous vs. gradual (second row of parentheses) (two-tailed). N per cell = 280 (shortlisting and simultaneous), 270 (gradual).

Overall, 33% of all the games in our data end up with a lottery, but there are some differences between mechanisms: 54% of lotteries with the simultaneous mechanism, and only 12% with the gradual vetoes. To evaluate the performance of each of these mechanisms, we re-calculate Table ?? by giving the rate at which all Pareto-inefficient options have been excluded by the subjects (i.e., if there is a tie, it only includes Pareto-efficient options), and the rate at which all non-consensual options have been excluded (i.e., if there is a tie, it is between consensual options only).

Table ?? reveals that the performance of the alternative mechanisms drops when we take ties into account. The most affected one is the simultaneous mechanism. This is not surprising given that it has a much higher rate of tied games than the gradual vetoes one. Under the simultaneous mechanism, the rate at which subjects manage to remove all Pareto-inefficient and non-consensual options drops well below those of the non-symmetric shortlisting mechanism, by up to 40% points. The differences are always statistically significant at a level of $p < 0.01$. In A3, these rates even fall below the random benchmark (36% vs 40%).

Yet, Table ?? shows that the gradual vetoes mechanism still performs well even with this

Table 7: Comparison of mechanisms: Rates of Pareto-efficient and consensual options.

	Shortlisting		Simultaneous		Gradual	
	Pareto	Consensus	Pareto	Consensus	Pareto	Consensus
A0	100%	82%	100%	76%	100%	76%
			(.)	(0.12)	(.)	(0.09)
					(.)	(0.89)
A2	88%	60%	92%	56%	87%	74%
			(0.12)	(0.35)	(0.87)	(0.00)
					(0.09)	(0.00)
A3	76%	76%	65%	65%	72%	72%
			(0.00)	(0.00)	(0.26)	(0.26)
					(0.07)	(0.07)
A5	91%	91%	71%	71%	96%	96%
			(0.00)	(0.00)	(0.01)	(0.01)
					(0.00)	(0.00)

Note: Entries are proportions. In parentheses are p-values of t-tests testing the equality of proportions between shortlisting vs. simultaneous/gradual (first row of parentheses) and between simultaneous vs. gradual (second row of parentheses) (two-tailed). N per cell = 280 (shortlisting and simultaneous), 270 (gradual).

measure of performance that takes ties into account. In most profiles, less than 10% of games end up with a tie. The rate at which subjects manage to remove all Pareto-inefficient or non-consensual options are very similar to those of the non-symmetric shortlisting mechanism. The largest difference, and the only one that is statistically significant at a level of $p < 0.01$, is a difference of 7% points for the selection rate of consensual options in A0. The other differences are smaller and not statistically significantly different from 0. Furthermore, the gradual vetoes mechanism performs better than the non-symmetric shortlisting mechanism one in A5 (96% vs 91%, statistically significant at $p < 0.05$). This is thus clear evidence of the performance of gradual vetoes mechanism is a strong alternative to the non-symmetric shortlisting mechanism that leads to similar rates of performance without introducing any asymmetry between subjects.

8 Results of individual decisions

As a final step in our analysis, we analyze the individual decisions made by the subjects in the simultaneous and gradual vetoes mechanisms.

Table 8: Comparison of mechanisms: Rates of Pareto-efficient and consensual options.

	Simultaneous		Gradual	
	Pareto	Consensus	Pareto	Consensus
A0	100% (.)	76% (0.12)	100% (.) (.)	76% (0.09) (0.89)
A2	92% (0.12)	56% (0.35)	87% (0.87) (0.09)	74% (0.00) (0.00)
A3	65% (0.00)	65% (0.00)	72% (0.26) (0.07)	72% (0.26) (0.07)
A5	71% (0.00)	71% (0.00)	96% (0.01) (0.00)	96% (0.01) (0.00)

Note: Entries are proportions. In parentheses are p-values of t-tests testing the equality of proportions between shortlisting vs. simultaneous/gradual (first row of parentheses) and between simultaneous vs. gradual (second row of parentheses) (two-tailed). N per cell = 280 (shortlisting and simultaneous), 270 (gradual).

We focus on the rate of vetoes that are put on the same options by both subjects. This indicates whether subjects manage to coordinate to remove the undesirable options. By definition, there cannot common vetoes under the non-symmetric shortlisting mechanism. We thus focus on the simultaneous and gradual vetoes mechanism. To make the data comparable, we focus on the two first vetoes put by each subject under both mechanisms. In the case of the simultaneous mechanism, this means analyzing the universe of decisions made by subjects. For the gradual vetoes mechanism, this means focusing on the two first rounds of elimination. In 63% of cases, the game stops there because there is only one option left. In appendix E, we report the results for all rounds of eliminations.

Table ?? reveals that with every single profile, coordination works better under the gradual vetoes mechanism than under the simultaneous one. The rate of vetoes put on the same options is between 8% and 17% points lower under the gradual vetoes mechanism ($p < 0.01$). This in turn explains why this mechanism produces better aggregate results: subjects can more easily coordinate to remove the undesirable options compared to the simultaneous

Table 9: Comparison of mechanisms: Rates of Pareto-efficient and consensual options considering ties.

	Simultaneous			Gradual		
	Pareto-only	Consensus-only	Ties	Pareto-only	Consensus-only	Ties
A0	100% (.)	63% (0.00)	32%	100% (.) (.)	71% (0.00) (0.05)	11%
A2	87% (0.70)	35% (0.00)	58%	86% (0.59) (0.87)	65% (0.21) (0.00)	16%
A3	36% (0.00)	36% (0.00)	72%	70% (0.13) (0.00)	70% (0.13) (0.00)	21%
A5	47% (0.00)	47% (0.00)	52%	96% (0.03) (0.00)	96% (0.03) (0.00)	1%

Note: Entries are proportions. In parentheses are p-values of t-tests testing the equality of proportions between shortlisting (Table 6) vs. simultaneous/gradual (first row of parentheses) and between simultaneous vs. gradual (second row of parentheses) (two-tailed). N per cell = 280 (simultaneous), 270 (gradual).

mechanism. This also explains why there are fewer ties.

9 Conclusion

This work focuses on the design of bargaining mechanisms that help reach efficient and consensual agreements in settings in which two players have possibly conflicting preferences, as is the case in most legal bargaining situations. We take as a point of comparison the non-symmetric shortlisting proposed and tested by ?. We confirm that this mechanism achieves high levels of efficiency but, due to its non-symmetric nature, generates asymmetries between the first and the second mover.

We then consider two alternative mechanisms: the simultaneous and the gradual vetoes mechanisms. While the simultaneous mechanisms performs poorly both in terms of efficiency and inequality, the gradual vetoes mechanism achieves high levels of efficiency, and even reduces inequality when compared to the non-symmetric shortlisting mechanism. It appears that the gradual revelation of vetoes by subjects acts as a coordination device, reducing the difference in payoffs between both subjects and helping them to remove the

Table 10: Comparison of mechanisms: individual strategies.

	Simultaneous Same vetoes	Gradual Same vetoes
A0	19%	8% (0.00)
A2	36%	25% (0.00)
A3	47%	30% (0.00)
A5	39%	26% (0.00)

Note: Entries are proportions of vetoes that are put on the same options by both subjects (out of two vetoes). In parentheses are p-values of t-tests testing the equality of proportions between simultaneous vs. gradual (two-tailed). N per cell = 1,120 (Simultaneous), 1,080 (Gradual).

dominated alternatives. While this finding is novel in the context of consensus-reaching mechanisms, it speaks to the literature on auction games where it is acknowledged that sequential auctions are easier to understand for subjects than simultaneous ones (see e.g., ?).

Further work devoted to the development of simple mechanisms that generate better and fairer agreements for two or more parties seems to be a natural research venue.

A Appendix: Equilibria of the gradual vetoes mechanism

This section shows that the subgame-perfect equilibrium outcomes of the gradual vetoes mechanism coincide with the consensual alternatives in the profiles used in the experiment.

The game we are considering is an extensive form game with complete information and simultaneous moves, and the definition of subgame-perfect equilibrium is standard: it is a strategy profile that generates a Nash equilibrium in each subgame.

The main result of this section holds under two assumptions: (i) players only use weakly undominated strategies and (ii) their preferences over lotteries satisfy stochastic dominance. Ruling out weakly undominated strategies implies that, at each stage, no player casts a veto against her best available alternative on the stage. Stochastic dominance is satisfied by most preference extensions in the literature. It simply requires that, when comparing two lotter-

ies, a shift in probability to strictly preferred alternatives yields strictly preferred lotteries. As in the case of subgame perfect equilibrium, we do not include its formal definition since it is standard.

Before laying out the analysis of the four profiles, we fully describe the outcomes with only two and three alternatives since this will be useful in the sequel.

A.1 Two alternatives

With two alternatives, only four preference profiles are possible: (i) $a \succ_i b$ for $i = 1, 2$, (ii) $b \succ_i a$ for $i = 1, 2$, (iii) $a \succ_1 b$ and $b \succ_2 a$ and (iv) $b \succ_1 a$ and $a \succ_2 b$. Since every player vetoes his worst alternative since this the only weakly non-dominated strategy, it follows that in profiles (i) and (ii), the only equilibrium outcome is the unanimously preferred alternative whereas in profiles (iii) and (iv) the only outcome is the lottery $uni(a, b)$.

A.2 Three alternatives

Each equilibrium selects a unique consensual alternative and the set of equilibrium outcomes corresponds to the set of consensual alternatives.

W.l.o.g we fix $a \succ_1 b \succ_1 c$ and consider the different preferences of player 2. This is possible since the game is symmetric so that permuting the name of the alternatives would give the corresponding payoff matrix and equilibrium outcome.

When $a \succ_2 b \succ_2 c$ and when $a \succ_2 c \succ_2 b$, a is the unique equilibrium outcome since the payoff matrix equals:

	b	c
b	a	a
c	a	a

When $b \succ_2 a \succ_2 c$, both a and b are equilibrium outcomes whereas b is the only equilibrium outcome when $b \succ_2 c \succ_2 a$ as one deduces from the payoff matrix:

	a	c
b	c	a
c	b	$uni(a, b)$

Finally, when $c \succ_2 a \succ_2 b$, the unique equilibrium outcome is a whereas when $c \succ_2 b \succ_2 a$, only b is selected in equilibrium as one can see in the next payoff matrix:

	a	b
b	c	$uni(a, c)$
c	b	a

A.3 Profile A0

In this profile $a \succ_i b \succ_i c \succ_i d \succ_i e$ for $i = 1, 2$. The restriction that voters rule out weakly dominated strategies implies that neither of the voters vetoes a at any stage. Thus, the only outcome of the game is a since in any subgame a is always unanimously preferred and hence never vetoed.

A.4 Profile A2

In this profile $a \succ_1 b \succ_1 c \succ_1 d \succ_1 e$ and $c \succ_2 b \succ_2 a \succ_2 d \succ_2 e$. The matrix of the game is as follows:

	b	a	d	e
b	$\Gamma(a, c, d, e)$	c	a or c	a or c
c	a	b	a or b	a or b
d	a or c	b or c	$\Gamma(a, b, c, e)$	b
e	a or c	b or c	b	$\Gamma(a, b, c, d)$

The equilibria for the subgames that with 4 non-vetoed alternatives are determined in the sequel; their outcome is irrelevant to prove that b is the unique equilibrium outcome. For instance, the strategy (c, a) is an equilibrium.

$\Gamma(a, c, d, e)$: This game admits two equilibrium outcomes, a or c , since restricted preferences are $a \succ_1 c \succ_1 d \succ_1 e$ and $c \succ_2 a \succ_2 d \succ_2 e$.

	a	d	e
c	d	a	a
d	c	a or c	$uni(a, c)$
e	c	$uni(a, c)$	a or c

$\Gamma(a, b, c, e)$: This game admits (c, a) which leads to b as the unique equilibrium as implied by the preferences $a \succ_1 b \succ_1 c \succ_1 e$ and $c \succ_2 b \succ_2 a \succ_2 e$.

	a	b	e
b	c	a or c	$uni(a, c)$
c	b	a	$uni(a, b)$
e	$uni(b, c)$	$uni(a, c)$	b

$\Gamma(a, b, c, d)$: This game admits (c, a) with outcome b as the unique equilibrium as implied by preferences $a \succ_1 b \succ_1 c \succ_1 d$ and $c \succ_2 b \succ_2 a \succ_2 d$.

	a	b	d
b	c	a or c	$uni(a, c)$
c	b	a	$uni(a, b)$
d	$uni(b, c)$	$uni(a, c)$	b

A.5 Profile A3

In this profile $a \succ_1 b \succ_1 c \succ_1 d \succ_1 e$ and $b \succ_2 a \succ_2 c \succ_2 d \succ_2 e$. The matrix of the game is as follows:

	a	c	d	e
b	$\Gamma(c, d, e)$	$\Gamma(a, d, e)$	$\Gamma(a, c, e)$	$\Gamma(a, c, d)$
c	$\Gamma(b, d, e)$	$\Gamma(a, b, d, e)$	$\Gamma(a, b, e)$	$\Gamma(a, b, d)$
d	$\Gamma(b, c, e)$	$\Gamma(a, b, e)$	$\Gamma(a, b, c, e)$	$\Gamma(a, b, c)$
e	$\Gamma(b, c, d)$	$\Gamma(a, b, d)$	$\Gamma(a, b, c)$	$\Gamma(a, b, c, d)$

where $\Gamma(X)$ stands for the subgame where players bargain over X . Whenever X has three alternatives, the outcome is determined directly by the analysis in Section ?? . This directly implies that the payoff matrix can be simplified as follows:

	a	c	d	e
b	c	a	a	a
c	b	$\Gamma(a, b, d, e)$	a or b	a or b
d	b	a or b	$\Gamma(a, b, c, e)$	a or b
e	b	a or b	a or b	$\Gamma(a, b, c, d)$

The subgames that involve 4 alternatives are determined in the sequel. Each of these subgames admits an equilibrium; moreover, their equilibrium outcome is irrelevant to determine the set of equilibrium outcomes over the whole game. It follows that the equilibrium outcomes are a (sustained by the profile (b, c)) and b (sustained by the profile (c, a)), as wanted.

$\Gamma(a, b, d, e)$: This game admits two equilibrium outcomes, a and b , with the restricted preferences $a \succ_1 b \succ_1 d \succ_1 e$ and $b \succ_2 a \succ_2 d \succ_2 e$.

	a	d	e
b	d	a	a
d	b	a or b	$uni(a, b)$
e	b	$uni(a, b)$	a or b

$\Gamma(a, b, c, e)$: This game admits two equilibrium outcomes, a or b , with the restricted preferences $a \succ_1 b \succ_1 c \succ_1 e$ and $b \succ_2 a \succ_2 c \succ_2 e$.

	a	c	e
b	c	a	a
c	b	a or b	$uni(a, b)$
e	b	$uni(a, b)$	a or b

$\Gamma(a, b, c, d)$: This game admits two equilibrium outcomes, a or b , with the restricted preferences $a \succ_1 b \succ_1 c \succ_1 d$ and $b \succ_2 a \succ_2 c \succ_2 d$.

	a	c	d
b	c	a	a
c	b	a or b	$uni(a, b)$
d	b	$uni(a, b)$	a or b

A.6 Profile A5

In this profile $a \succ_1 b \succ_1 c \succ_1 d \succ_1 e$ and $e \succ_2 d \succ_2 c \succ_2 b \succ_2 a$. The matrix of the game is as follows:

	a	b	c	d
b	d	$\Gamma(a, c, d, e)$	d	c
c	d	d	$\Gamma(a, b, d, e)$	b
d	c	c	b	$\Gamma(a, b, c, e)$
e	c	c	b	b

It follows that c is the unique equilibrium outcome with the strategy (e, a) being an equilibrium. This outcome is independent of the outcomes of the subgames that involve 4 alternatives, analyzed in the sequel.

$\Gamma(a, c, d, e)$: This game admits a unique equilibrium (e, a) with outcome $uni(c, d)$ with preferences $a \succ_1 c \succ_1 d \succ_1 e$ and $e \succ_2 d \succ_2 c \succ_2 a$.

	a	d	e
c	d or e	d	$uni(a, e)$
d	$uni(c, e)$	$uni(a, e)$	c
e	$uni(c, d)$	$uni(a, d)$	$uni(a, c)$

$\Gamma(a, b, d, e)$: This game admits a unique equilibrium (e, a) with outcome $uni(b, d)$ since restricted preferences are given by $a \succ_1 b \succ_1 d \succ_1 e$ and $e \succ_2 d \succ_2 b \succ_2 a$.

	a	b	d
b	$uni(d, e)$	d	$uni(a, e)$
d	$uni(b, e)$	$uni(a, e)$	b
e	$uni(b, d)$	$uni(a, d)$	$uni(a, b)$

$\Gamma(a, b, c, e)$: This game admits a unique equilibrium (e, a) with outcome $uni(b, c)$ as preferences over (a, b, c, e) are given by $a \succ_1 b \succ_1 c \succ_1 e$ and $e \succ_2 c \succ_2 b \succ_2 a$.

	a	b	c
b	$uni(c, e)$	c	$uni(a, e)$
c	$uni(b, e)$	$uni(a, e)$	b
e	$uni(b, c)$	$uni(a, c)$	$uni(a, b)$

B Coordination patterns in experimental sessions

It is thus possible that subjects learn how to play a strategy that increases their payoff during the experiment. Consequently, the results of games played at the first rounds of the experiment may differ from the ones at the last rounds. The tables below report the results of the experimental session by distinguishing the games happening at the beginning of the sessions and those at the end. In doing so, we aim to identify possible coordination and learning patterns between subjects.

B.1 Coordination patterns with the non-symmetric shortlisting mechanism

In the data of ?, there are 20 rounds in each session. To identify coordination patterns between subjects, we reproduce Tables 3 and 4 of the main text by splitting the sample in two: the games played in the 20 first rounds of the session on the one hand and those played in the 20 last rounds on the other. In our data, there are also 20 rounds per session, so we use the same split-sample strategy. Note however that the preference profile A0 was always played first, so there is an empty cell for this profile in the rows for the 20 last rounds. Furthermore, in our data, each pair of subjects together play the same games five times. Hence, we also split the sample between the three first and two last repetitions within each pair of subjects.

We find some coordination patterns between subjects, but only a few are systematic across preference profiles. The patterns are indeed quite different depending on the profile: in some, efficiency increases and inequality decreases as the experiment advances (e.g. Pf5), in others, this pattern is reversed (e.g., A2). The most systematic pattern deals with the first-mover advantage: the first-mover advantage tends to increase as the experiment progresses in both ? and our data. This pattern is observed in virtually all profiles. It suggests that subjects learn how to take advantage of their position during the experiment.

	Efficiency		Inequality	
	20 first rounds	20 last rounds	20 first rounds	20 last rounds
A0	20.00	20.00	3.00	1.90
A2	27.96	27.55	5.92	6.35
A3	34.62	34.25	4.87	4.83
Pf 5	25.40	26.56	8.15	7.56

Note: Coordination efficiency and inequality in ?.

	First-mover advantage	
	20 first rounds	20 last rounds
A0	-1.17	-1.20
A2	2.92	4.05
A3	1.72	3.62
Pf 5	0.60	5.27

Note: First-mover advantage in ?.

	Pareto		Consensus	
	20 first rounds	20 last rounds	20 first rounds	20 last rounds
A0	100%	100%	79%	87%
A2	90%	88%	31%	25%
A3	97%	97%	97%	97%
Pf 5	84%	94%	84%	94%

Note: Rates of Pareto-efficient and consensual options in ?.

	Efficiency		Inequality	
	20 first rounds	20 last rounds	20 first rounds	20 last rounds
A0	20.00	.	2.50	.
A2	29.00	26.75	2.87	2.75
A3	30.25	30.55	3.65	3.89
A5	38.00	38.05	0.00	0.00

Note: Efficiency and inequality in data (20 first vs. 20 last rounds).

	Efficiency		Inequality	
	3 first repetitions	2 last repetitions	3 first repetitions	2 last repetitions
A0	20.00	20.00	2.68	2.23
A2	26.78	28.30	2.86	2.68
A3	30.62	30.18	3.84	3.75
A5	38.39	37.50	0.00	0.00

Note: Efficiency and inequality in data (3 first repetitions vs. 2 last repetitions).

	First-mover advantage	
	20 first rounds	20 last rounds
A0	-0.43	.
A2	-1.62	0.45
A3	0.15	1.39
A5	0.00	0.00

Note: First-mover advantage in data (20 first vs. 20 last rounds).

First-mover advantage		
	3 first repetitions	2 last repetitions
A0	-0.53	-0.27
A2	-0.48	0.36
A3	0.98	0.89
A5	0.00	0.00

Note: First-mover advantage in data (3 first vs. 2 last repetitions).

	Pareto		Consensus	
	20 first rounds	20 last rounds	20 first rounds	20 last rounds
A0	100%	.	82%	.
A2	95%	85%	66%	57%
A3	73%	78%	73%	78%
A5	89%	92%	89%	92%

Note: Rates of Pareto-efficient and consensual options in data (20 first vs. 20 last rounds).

	Pareto		Consensus	
	3 first repetitions	2 last repetitions	3 first repetitions	2 last repetitions
A0	100%	100%	80%	85%
A2	85%	92%	56%	65%
A3	77%	75%	77%	75%
A5	93%	87%	93%	87%

Note: Rates of Pareto-efficient and consensual options in data (3 first vs. 2 last repetitions).

B.2 Coordination patterns with other mechanisms

We reproduce the results of Tables 5, 6 and 7 of the text using the same sample split-sample strategy than above. Again, we do not find much pattern of coordination between subjects

as the experimental session advance. The only (mild) pattern that we find is for the simultaneous mechanism: the rates at which Pareto-efficient and consensual options are selected tend to increase as the experiment progresses, increasing efficiency but also inequality. This suggests that subjects managed to coordinate and learn how to play the most profitable strategy for them as the experiment advances. Note however that these increases are small, and cannot be found for the gradual vetoes mechanism.

	Efficiency		Inequality	
	20 first rounds	20 last rounds	20 first rounds	20 last rounds
A0	20.00	.	3.07	.
A2	27.40	28.61	3.70	3.50
A3	27.37	28.77	3.00	3.32
A5	35.50	35.00	0.00	0.00

Note: Efficiency and inequality with the simultaneous mechanism (20 first vs. 20 last rounds).

	Efficiency		Inequality	
	3 first repetitions	2 last repetitions	3 first repetitions	2 last repetitions
A0	20.00	20.00	3.45	2.50
A2	27.68	28.93	3.75	3.30
A3	28.36	28.39	3.24	3.21
A5	34.40	36.34	0.00	0.00

Note: Efficiency and inequality with the simultaneous mechanism (3 first vs. 2 last repetitions).

	Efficiency		Inequality	
	20 first rounds	20 last rounds	20 first rounds	20 last rounds
A0	20.00	.	3.04	.
A2	26.78	27.11	0.78	1.55
A3	31.72	28.75	4.17	3.30
A5	38.89	39.83	0.00	0.00

Note: Efficiency and inequality with the gradual vetoes mechanism (20 first vs. 20 last rounds).

	Efficiency		Inequality	
	3 first repetitions	2 last repetitions	3 first repetitions	2 last repetitions
A0	20.00	20.00	3.09	2.96
A2	26.60	27.59	1.30	1.29
A3	29.54	30.05	3.55	3.66
A5	39.62	39.35	0.00	0.00

Note: Efficiency and inequality with the gradual vetoes mechanism (3 first vs. 2 last repetitions).

	Pareto		Consensual	
	20 first rounds	20 last rounds	20 first rounds	20 last rounds
A0	100%	.	76%	.
A2	88%	94%	51%	59%
A3	60%	66%	60%	66%
A5	73%	69%	73%	69%

Note: Rates of Pareto-efficient and consensual options with the simultaneous mechanism (20 first vs. 20 last rounds).

	Pareto		Consensual	
	3 first repetitions	2 last repetitions	3 first repetitions	2 last repetitions
A0	100%	100%	73%	81%
A2	90%	95%	52%	62%
A3	65%	64%	65%	64%
A5	66%	78%	66%	78%

Note: Rates of Pareto-efficient and consensual options with simultaneous mechanism (3 first vs. 2 last repetitions).

	Pareto		Consensual	
	20 first rounds	20 last rounds	20 first rounds	20 last rounds
A0	100%	.	76%	.
A2	87%	88%	79%	72%
A3	83%	66%	83%	66%
A5	92%	98%	92%	98%

Note: Rates of Pareto-efficient and consensual options with the gradual vetoes mechanism (20 first vs. 20 last rounds).

	Pareto		Consensual	
	3 first repetitions	2 last repetitions	3 first repetitions	2 last repetitions
A0	100%	100%	76%	76%
A2	86%	90%	73%	77%
A3	71%	73%	71%	73%
A5	97%	95%	97%	95%

Note: Rates of Pareto-efficient and consensual options with the gradual vetoes mechanism (3 first vs. 2 last repetitions).

	Pareto-only		Consensual-only		Ties	
	20 first rounds	20 last rounds	20 first rounds	20 last rounds	20 first rounds	20 last rounds
A0	100%	.	63%	.	32%	.
A2	80%	91%	28%	38%	64%	54%
A3	25%	40%	25%	40%	71%	73%
A5	47%	47%	47%	47%	53%	52%

Note: Rates of Pareto-efficient and consensual options considering ties with simultaneous mechanism (20 first vs. 20 last rounds).

	Pareto-only		Consensual-only		Ties	
	3 first repetitions	2 last repetitions	3 first repetitions	2 last repetitions	3 first repetitions	2 last repetitions
A0	100%	100%	58%	71%	36%	25%
A2	85%	89%	30%	41%	62%	52%
A3	35%	37%	35%	37%	76%	67%
A5	39%	59%	39%	59%	60%	40%

Note: Rates of Pareto-efficient and consensual options considering ties with simultaneous mechanism (3 first vs. 2 last repetitions).

	Pareto-only		Consensual-only		Ties	
	20 first rounds	20 last rounds	20 first rounds	20 last rounds	20 first rounds	20 last rounds
A0	100%	.	71%	.	11%	.
A2	86%	87%	68%	84%	16%	16%
A3	82%	64%	82%	64%	26%	19%
A5	92%	97%	92%	97%	0%	1%

Note: Rates of Pareto-efficient and consensual options considering ties with the gradual vetoes mechanism (20 first vs. 20 last rounds).

	Pareto-only		Consensual-only		Ties	
	3 first repetitions	2 last repetitions	3 first repetitions	2 last repetitions	3 first repetitions	2 last repetitions
A0	100%	100%	72%	69%	10%	11%
A2	84%	90%	61%	71%	18%	12%
A3	70%	70%	70%	70%	20%	22%
A5	96%	94%	96%	94%	1%	1%

Note: Rates of Pareto-efficient and consensual options considering ties with the gradual vetoes mechanism (3 first vs. 2 last repetitions).

C Full results

The table below presents the full results of our experimental sessions. It gives the selection rate of each option, a , b , c , d , and e , under each profile of preferences and mechanism.

	Shortlisting	Simultaneous	Gradual vetoes
A0			
a	2.50%	5.36%	4.07%
b	5.36%	9.29%	10.00%
c	81.79%	76.43%	74.07%
d	6.07%	7.14%	9.26%
e	4.29%	1.79%	2.59%
A2			
a	90.71%	70.71%	95.93%
b	2.14%	15.71%	2.96%
c	5.00%	9.64%	1.11%
d	1.07%	2.50%	0.00%
e	1.07%	1.43%	0.00%
A3			
a	13.21%	17.86%	4.44%
b	60.00%	56.07%	73.33%
c	14.64%	17.86%	8.52%
d	10.36%	6.43%	8.15%
e	1.79%	1.79%	5.56%
A5			
a	47.50%	30.71%	30.00%
b	28.57%	33.93%	41.11%
c	15.71%	25.00%	20.74%
d	6.79%	7.50%	5.93%
e	1.43%	2.86%	2.22%

Note: Entries are rates at which each option is selected in each profile and each mechanism in our data.

D First-mover advantage in alternative mechanisms

The table below presents the first-mover advantage for the alternative mechanisms. Unsurprisingly, we do not find any effect given that, in these mechanisms, which subject play “first” or “second” is purely artificial. They indeed both play at the same time. Yet, for coding purposes, there is a first and one second mover in our Z-tree program. This is what we use in the analysis below.

	Simultaneous	Gradual vetoes
A0	0.93	0.89
A2	0.00	-0.19
A3	-0.16	-0.30
A5	0.00	0.00

Note: First-mover advantage in alternative mechanisms. Entries are average differences between the payoff of the first-mover and the payoff of the second-mover in our data.

E Analysis of individual decisions

The table below presents the detail of individual decisions of subjects under the gradual vetoes mechanism. It shows the rate of common vetoes, i.e., vetoes that are put on the same option by both subjects at the same time, at each round of elimination: first, second, and third. Mechanically, it takes at least two rounds to reach a final selected option. 63% of all games finish there, and 96% finish after a third round. Since the numbers are too small, we do not include the fourth round in the table (depending on the profile, the N is as small as 8). We observe that the rate of common vetoes increases with the number of rounds. This is not particularly surprising given that there are fewer and fewer options available and that subjects are likely to pick the same veto, even by chance.

Same vetoes			
	Round 1	Round 2	Round 3
A0	10%	7%	20%
A2	17%	33%	46%
A3	21%	39%	58%
A5	23%	30%	90%

Note: Entries are the rate of common vetoes at each round of elimination in the gradual vetoes mechanism.

F Analysis of data from the CREST lab

For our data, we conducted 6 experimental sessions: 3 in the PSE lab and 6 in the CREST lab. To discard any possibility to our results are driven by a lab effect, we reproduce below the analysis of the main text by focusing on data coming from sessions organized in the CREST lab. All three mechanisms were covered in the sessions of the CREST lab whereas only the non-symmetric shortlisting mechanism was covered in the PSE lab. Focusing on data from the CREST lab, we still have 400 games for the simultaneous mechanism (1 session), 800 games for the simultaneous mechanism (2 sessions) and 1,080 games for the gradual vetoes mechanism (3 sessions).

The results are remarkably similar to those that include data from both labs: the results of the gradual vetoes mechanism are not statistically significantly different from those of the non-symmetric shortlisting mechanism, and when they are it is the gradual vetoes mechanism that performs better. By contrast, the performance of the simultaneous mechanism is poorer than the non-symmetric shortlisting and gradual vetoes mechanisms although differences are not always statistically significant due to the relatively low number of observations.

	Shortlisting		Simultaneous		Gradual	
	Efficiency	Inequality	Efficiency	Inequality	Efficiency	Inequality
A0	20.00	2.60	20.00 (.)	2.95 (0.62)	20.00 (.) (.)	3.04 (0.52) (0.87)
A2	26.10	1.30	27.75 (0.08)	3.15 (0.00)	27.00 (0.36) (0.29)	1.30 (0.99) (0.00)
A3	28.80	3.40	28.77 (0.98)	3.32 (0.80)	29.74 (0.38) (0.26)	3.59 (0.47) (0.21)
A5	38.00	0.00	35.25 (0.00)	0.00 (.)	39.52 (0.00) (0.00)	0.00 (.) (.)

Note: Comparison of mechanisms: efficiency and inequality (CREST lab only)

	Shortlisting		Simultaneous		Gradual	
	Pareto	Consensus	Pareto	Consensus	Pareto	Consensus
A0	100%	81%	100%	76%	100%	76%
			(.)	(0.33)	(.)	(0.30)
					(.)	(0.99)
A2	83%	70%	90%	58%	87%	74%
			(0.08)	(0.05)	(0.27)	(0.39)
					(0.38)	(0.00)
A3	68%	68%	66%	66%	72%	72%
			(0.80)	(0.80)	(0.47)	(0.47)
					(0.21)	(0.21)
A5	89%	89%	70%	70%	96%	96%
			(0.00)	(0.00)	(0.01)	(0.01)
					(0.00)	(0.00)

Note: Comparison of mechanisms: Rates of Pareto-efficient and consensual options (CREST lab only).

	Simultaneous			Gradual		
	Pareto-only	Consensus-only	Ties	Pareto-only	Consensus-only	Ties
A0	100%	61%	32%	100%	71%	11%
	(.)	(0.00)		(.)	(0.04)	
				(.)	(0.05)	
A2	83%	36%	56%	86%	65%	16%
	(0.91)	(0.00)		(0.43)	(0.38)	
				(0.40)	(0.00)	
A3	40%	40%	73%	70%	70%	21%
	(0.00)	(0.00)		(0.66)	(0.66)	
				(0.00)	(0.00)	
A5	46%	46%	53%	96%	96%	1%
	(0.00)	(0.00)		(0.02)	(0.02)	
				(0.00)	(0.00)	

Note: Comparison of mechanisms: Rates of Pareto-efficient and consensual options considering ties (CREST lab only)