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Flip a coin or vote: An Experiment on Choosing Group Decision

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Flip a coin or vote: An Experiment on Choosing Group Decision Rules*

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Abstract

Before a group can take a decision, its members must agree on a mechanism to aggregate individual preferences. In this paper we present the results of an experiment on the influence of private payoff information and the role of the available alternatives on individuals' mechanism choices in such group choice situations. While efficient mechanisms are desirable, we experimentally show that participation constraints can prevent their implementation. We find strong indications that individual preferences for choice rules are sensitive to individual expected payoffs. Our results highlight the importance of considering participation constraints when designing choice institutions.

JEL classification: C91,C92, D70, D82

Keywords: Experimental economics; Group choice; Choice rules; Mechanisms; Participation constraints; Two-stage voting, Bayesian games

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1 Introduction

Before a group or society can take a decision, whether it is about what restaurant to visit, or whether to implement a social security reform, the group has to select a decision rule to aggregate individual preferences. To maximizes the value of the final decision to the group, its members should agree on a mechanism that maps the vector of individual preferences into an efficient decision. However, in a seminal paper Myerson and Satterthwaite (1983) show that if individuals are privately informed about their preferences over outcomes, there is no efficient decision rule that is unanimously preferred over the non-implementation status quo. If a participant can force non-implementation, she[1] should do so whenever she learns that the (proposed) decision rule can lead to outcomes she likes less than the status quo. Because of the existence of an outside option (the status quo), some individuals are better off not participating in the efficient mechanism at all. In this paper we address the problem of (efficient) mechanism selection in a group decision experiment. We study binary comparisons between four decision rules and investigate the role of different outside options and private information on subjects' mechanism choices.

In a collective decision about the implementation of an indivisible public project, an optimal mechanism results in implementation if the sum of individual valuations is larger than zero. While such mechanisms exist and groups can in theory replace any existing mechanism by a more efficient one, other mechanisms are often selected in practice. The theoretical literature has identified private information and outside options as key aspects of the mechanism choice situation that determine whether an efficient mechanism can be implemented. Comparing Myerson and Satterthwaite (1983), Schmitz (2002), Segal and Whinston (2011) and Grüner and Koriyama (2012) shows that, if individuals can better serve their interest in an inefficient alternative than in the efficient mechanism, they have no reason to select the efficient mechanism. Additionally, the Myerson-Satterthwaite theorem illustrates that any individual with private information about her project payoff should use this information to determine her preferences over the mechanisms. Individuals that dislike the public project often have a better chance of blocking the project in an inefficient mechanism, and therefore are worse off under the efficient mechanism.

In this paper we study the influence of both of these aspects on individuals' mechanism choices. We conduct an experiment with a two-stage voting procedure in a collective decision making situation. In the first stage (mechanism choice), individuals select their preferred decision rule from two available mechanisms. In the second stage, each three-person group applies the chosen mechanism to determine the group decision on the provision of an indivisible public good (implementation decision). By varying the distribution of private valuations for the public good between treatments and the available mechanisms between rounds, we investigate the role of the outside option on the mechanism choice. Furthermore, we vary the moment at which the private information about the individual project payoffs is revealed within treatment. This design enables us to test the relationship between preferences and the revelation of private information within subject. Understanding how the revelation of private information alters choices, can help us to shed light on problems that occur in many choice institutions. Since in many real-life situations decision rules can be altered in the interim stage where individuals have private information, we consider this aspect particularly important.

In our experiment the mechanism selection is done via a random dictator procedure. We ask subjects

[1] For better readability only female pronouns are used.

to declare their preferred mechanism out of 2 options. After each subject has selected her preferred mechanism in the first stage, one group member is randomly chosen in stage two and her preferred mechanism is implemented as the group decision rule. While this random dictator rule is neither an optimal nor a realistic procedure, it elicits the willingness to participate in a mechanism without any distortions. It ensures incentive compatibility, while it allows us to present the required choices in a randomized order to minimize presentation or order effects. The four group decision rules we use are: the Simple Majority (SM) mechanism, a first-best optimal direct revelation game known as the Arrow, d'Aspremont Gerard-Varet (AGV) mechanism,[2] the non-implementation Status Quo (NSQ) and the flip of a fair coin, or Random implementation (RAND). Since this two-stage voting procedure is a game of imperfect information, there are several measures of efficiency that could be relevant. We measure efficiency through realized values, and thus efficiency refers to ex-post classical efficiency.

With the chosen design we can conduct a strong within-subject test of the Myerson-Satterthwaite theorem by comparing subjects' mechanism choices in an ex ante and an ad-interim stages. Ex ante, an uninformed individual should prefer the more efficient mechanism. Ad interim, if she knows she has a negative payoff from project implementation, the same individual should prevent the use of any mechanism that allows for project implementation, and thus prefer NSQ. By changing the two available mechanisms between rounds, we can test the predictions of Schmitz (2002), Segal and Whinston (2011) and Grüner and Koriyama (2012) that participation constraints are less binding if the outside option includes risky outcomes. The variation of the potential valuations for the public good over treatments allows us to demonstrate that the observed change in preferences is driven by changes in expected payments.

Our results demonstrate that without private payoff information individuals select efficient mechanisms. Subjects choose the more efficient mechanism because it yields the largest expected payoff ex ante. Ad interim, when they are informed about their valuation for the project, they only prefer the (more) efficient mechanisms if thet have a positive private valuation, otherwise they opt for the non-implementation status quo whenever possible, exactly as predicted by Myerson and Satterthwaite (1983). Interestingly, we find indications that the differences in expected payoffs from the mechanisms *as they are played in the lab*, strongly influence the choices made. These results illustrate the importance of thinking about the decision rule to use in a group, or committee, before this group faces any actual decisions. Deciding upon a decision rule after an issue comes up is very inefficient. This effect is, for instance, sometimes clearly observed in hiring committees at universities and research institutes. Committees that fail to agree upon a decision rule before meeting the candidates, will likely have different subgroups within the committee that favor different candidates. In the ensuing discussion, the subgroups can propose the criteria that favor their preferred candidate. With different preferred candidates this will lead to a discussion about what set of criteria to use, and a costly delay of the decision or even a failure to hire a suitable candidate is likely.

Our results from the ad-interim stage suggest that it can be feasible to implement an efficient mechanism as long as the outside option yields uncertain results. With a risky outside option, individuals that know they do not want to implement the public project have no guaranteed way of blocking the

[2] This mechanism is also known as the expected externality mechanism. It was originally proposed in Arrow (1979) and d'Aspremont and Gérard-Varet (1979).

implementation. In the absence of a secure non-implementation option, these subjects prefer the (more) efficient mechanisms because it allows them to influence outcomes. Since both subjects with positive and subjects with negative valuations of the public project prefer to have influence over the outcome, agreements on efficient mechanisms are possible. These results support the predictions of Schmitz (2002), Segal and Whinston (2011) and Grüner and Koriyama (2012).

With a safe, non-implementation status quo, our three-person groups are already severely hindered in implementing an efficient mechanism. Public projects and reforms usually require all involved individuals to cooperate, pay part of the price (through taxes for instance), permit use of their resources or even the reorganization (or removal) of their property rights. In a completely voluntary setting the kind of inertia caused by a non-implementation status quo in our experiment, would make public projects virtually impossible to negotiate. Simultaneously, virually all decision bodies require a proposal be brought up for consideration before they can change the status quo, such that this type of intertia can occur virtually everywhere.

In many situations the mechanism choice takes place when agents are already informed about their preferences over outcomes and the outside option is fixed by the existing situation. If the existing situation does not involve an efficient mechanism the group might need coercive power to force individual members to cooperate. As a consequence, our results provide a rationale for the role of coercive power in group decisions. By forcing group members to participate in individual projects, the group surpuls can be increased since individual projects no longer need to satisfy all participation constraints. If an entity has coercive power, the participation constraints of individuals become less relevant. Furthermore, our results also provide evidence that specifying decision procedures in constituting documents is a good idea. By setting a standard procedure and demanding that these procedures can only be changed through a considerably more demanding procedure, the drafters of the constitution ensure that the mechanisms are de facto established in an ex-ante stage.

The rest of the paper is organized as follows: section 2 summarizes the previous research on group mechanism choices and participation constraints and section 3 outlines the experimental design and the three treatments. Section 4 states the theoretical predictions, while section 5 describes the results on all predictions and discusses further findings. Finally, section 6 concludes.

2 Related literature

Our setup is most closely related to the literature discussing the choice of voting rules or constitutions. The discussion on constitutional choice features two (connected) ideas: stability and inertia. Since these constitutions contain many meta-rules, changing them often is undesirable. In a seminal contribution Barbera and Jackson (2004) show that a constitution that specifies the same simple majority rule to implement policy and to change the constitution, can be hijacked by self-interested majorities. To ensure a stable constitution, it has to adhere to a property these authors call self-stability. Under the rules set-out by the constitution, the society should not decide to change the constitution. Requiring a qualified majority to change the constitution is an easy way to create more self-stability. A similar idea is proposed in an explicitly dynamic setting by Acemoglu et al. (2012). Given some constraints that guarantee sufficient patience and prevent Condorcet-like voting cycles, these authors show that the stability of the constitution crucially depends on the set of other dynamically stable constitutions. As long as no winning coalition can be found that prefers another stable constitution, the state is stable. In this sense the set of stable coalitions form long-term outside options that should not be preferable to the agents. These results do not imply, however, that the self-stable states are efficient (especially in the short-run). In fact, the authors argue that the inefficiencies in self-stable states could cause several of the seemingly costly problems observed in many systems.

Inertia is the central concept in a second strand of research, the social choice literature. This, mostly theoretical, literature is riddled with impossibility theora that show it is not possible to design a social choice rule, or an implementing mechanism, that combines some set of desirable properties in every imaginable circumstance. The most famous impossibility result by Arrow (1950) states that non-dictatorship, Pareto efficiency and independence of irrelevant alternatives cannot be obtained by any social choice function for all potential preference profiles. In similar vein, Myerson and Satterthwaite (1983) show that even in a setting with only two players and independent valuations, an efficient, interim incentive compatible and budget neutral mechanism for trade does not exists, as long as players can guarantee themselves a sufficiently large payoff when not trading.[3] The result that individual rationality, incentive compatibility and budget balance are incompatible for a N-player public good setting, of which our experiment is a special case, was proven by Mailath and Postlewaite (1990). Similar results are obtained by Güth and Hellwig (1986, 1987) for the private supply of a public good. When the mechanism to decide on production levels is selected through a veto rule (i.e. unanimous acceptation), efficient production cannot be reached unless a subsidy is provided. These impossibility results illustrate how a certain non-implementation status quo can stifle any chance of (efficient) mechanism change.

Several papers have derived possibility results that illustrate the dependence of impossibility results on the assumptions on the status quo that occurs if the mechanism is rejected. Cramton et al. (1987) show with a status quo of a more or less equal distribution of the good (ownerships rights in their setting), it is possible to design an auction like procedure that is both ad interim incentive compatible and ex post efficient, without requiring subsidies. Schmitz (2002) shows that decisions on public good provisions can be made through an efficiently designed mechanism for some particular status quo settings. In many cases a status quo, either an interim allocation or a probability of implementation between 0 and 1, can be found that allows an efficient implementation and does not violate the incentive compatibility constraints at the interim stage. In case the valuation of the public good is identically and independently distributed, such a status quo can always be found. This implies that both in the bargaining game of Myerson and Satterthwaite (1983) and in a public good provision problem, a status quo exists that will incentivize individuals to accept an efficient mechanism ad interim. Segal and Whinston (2011) make a similar point by demonstrating how background risk, or a status quo that is not quite as secure as the no-trade outcome, can increase the willingness of individuals to accept mechanism changes. Most importantly for our paper, their proposition 1 states that individuals are willing to accept a more efficient mechanism, if it has the same equilibrium distribution over allocations as the status quo, or default mechanism. Grüner and Koriyama (2012) illustrate that it is even possible for groups to shift from a (simple) majority voting system to the AGV mechanism, without violating interim participation constraints. This result is

[3] An older, less general result can be found in Chatterjee (1982). While a more general statement can be found in a.o. Segal and Whinston (2014). The interpretation in this paper is mostly due to Cramton et al. (1987).

quite remarkable, since majority systems are much more efficient than a fixed or random status quo. The efficiency gains of moving to the AGV are therefore limited. However, for some settings and distributions the gains are large enough to compensate individuals for the potential loss in information rents.

Two closely related experimental papers study the effect of social preferences on mechanism choice. Bierbrauer et al. (2014) identify the theoretically optimal mechanism assuming social preferences of the players exist. Their experiment shows that choices for a small, but significant number of subjects, are better explained by including other-regarding preferences. They also illustrate that if enough of such subjects are present, the optimal mechanism with strictly self-interested rational players is no longer optimal to a social planner. The article most closely related to ours is Engelmann and Grüner (2013). In their experiments, groups of five subjects select their preferred mechanism out of 5 potential voting mechanisms. The voting mechanisms differ in the amount of positive votes required for implementation of a common project. Individuals differ in their utility from project implementation (utility is equal to zero if it is not implemented). A completely self-interested and rational subject should always opt for the voting rule that requires only one (all five) vote(s) for implementation, if she has a positive (negative) valuation of implementation, while voting positively (negatively) in the implementation decision. However, the authors find that subjects often choose mechanisms that require two, three or four positive votes for implementation. These deviations could be explained by efficiency or pro-social concerns in the mechanism choice stage. The authors note that this implies possible efficiency gains in decision making by letting groups vote on voting rules, before they vote on issues. If individuals indeed decide upon mechanisms with more efficiency/equality related criteria then they use for implementation decisions, participation constraints are less binding.

3 Experimental design

We first describe the game subjects participated in and explain the mechanisms used. We then outline the treatments and describe the procedures of the experiment. The only difference between treatments is the set of potential private valuations for the public project. The underlying procedures, game and all other details of the experiment, e.g. number of rounds, group size, available mechanisms, etc. are identical across all treatments.

3.1 The game

Subjects interact in groups of three and each group faces the question whether or not to implement an indivisible public project. Non-implementation results in a zero payoff for all subjects. If the project is implemented each player receives a project payoff equal to her valuation. The private valuations are drawn independently from a known uniform distribution on a given set of four values that depend on the treatment. The distribution and its support are common knowledge and remain the same within a session.

Each of the 18 experimental rounds proceeds in two steps. First, subjects select a mechanism to make the group decision. Second, the group decides about the implementation of the public project through the chosen mechanism. In all treatments the same four mechanisms are used and in each round subjects chose between two of them. The mechanisms we consider are:

Mechanism I AGV mechanism

All group members report a valuation for the implementation of the project. They can only report valuations that are present in the type space. If the sum of reported valuations is larger than zero the project is implemented, otherwise the project is not implemented. Independent of project implementation, subjects pay or receive a transfer that depends on the vector of reported valuations.

Mechanism II Voting - Simple Majority (SM)

All group members vote for or against the project (no abstention). If two or more group members vote for implementation the project is implemented, otherwise the project is not implemented.

Mechanism III Non-implementation Status Quo (NSQ)

The public project is not implemented.

Mechanism IV Random implementation (RAND)

Whether the public project is implemented depends on the flip of a fair coin. If the result of the coin toss is heads, the project is implemented otherwise the project is not implemented. Therefore this mechanism has a 50% probability of implementation independent of subjects' valuations.

At the beginning of a round subjects are informed about the two available mechanisms. They cannot influence which mechanisms are available in a round, and the order of the comparisons is randomly altered between sessions. Each subject privately selects one of the two given mechanisms. After mechanism choices have been recorded, the computer randomly picks one group member as the dictator and the mechanism chosen by this random dictator is executed. All group members are informed of the selected mechanism, but they do not learn whose choice was selected nor what mechanism the other two subjects selected.

If the AGV or SM mechanism is selected, all group members state a valuation for the project (AGV) or vote on the implementation of the project (SM). If the NSQ or RAND mechanism is selected no further action by the subjects is required. The computer determines whether the project is implemented through the selected mechanism and payoffs are realized accordingly. The project payoff is equal to the private valuations if the project is implemented, otherwise the project payoffs are 0. In the AGV subjects additionally pay or receive transfers that depend on the reported valuations but not on project implementation.

The experiment proceeds in two parts. In the first part, the first twelve rounds, subjects learn their private valuation for the public project ad interim, that is, after choosing their preferred mechanism but before the mechanism is played. In part two, the last six rounds, subjects are informed about their private valuation for the project at the start of each round and therefore are aware of their valuation when choosing a mechanism. Subjects are never informed about valuations of other subjects. Our subjects face all six possible binary mechanism choices twice in the ex-ante condition (rounds 1-12), before going to the ad-interim rounds (rounds 13-18). Since subjects make the mechanism choice both in an ex-ante and an ad-interim setting, we can compare mechanism choices in both settings within subjects.

By design, the choices in the ex-ante rounds are not influenced by previous experiences in the ad-interim rounds. Since we consider the expected value calculations to be more demanding in the ex-ante rounds than in the ad-interim rounds, we chose a design that delivers the cleanest decisions in the ex-ante rounds as our main treatment. Because we did not observe any signs of consistency concerns or order effects in the choices made by our subjects, we did not conduct sessions with a reversed order.

The design is in many aspects similar to the two-step voting procedure studied by Engelmann and Grüner (2013), but there are three important differences. First, in our study subjects choose between two mechanisms rather than five. This clearly identifies the outside option. Second, we have four very different mechanisms, rather than five mechanisms from the class of simple voting rules. This allows us to make the same comparisons studied in the theoretical papers. We describe the mechanisms used and the reasons for selecting these four mechanism in the next section. Third, Engelmann and Grüner (2013) did not look at the effects of private information on the behavior of subjects. As we show in this paper, the presence of private information fundamentally changes the choices made by our subjects.

3.2 The four mechanisms

The four mechanisms are chosen because of their theoretical implications and relevance for group decision making. The AGV mechanism, or expected externality mechanism, is the theoretically optimal mechanism for decisions about indivisible public projects, like reforms. It is incentive compatible, ex-post budget balanced and induces efficient implementation. It was first suggested by Arrow (1979) and d'Aspremont and Gérard-Varet (1979) who also give a formal proof of its properties. The AGV is a direct revelation game in which all individuals send a message from the type space (they can behave like other types but not invent new types). Based on the reports the surplus generated by the project is calculated and the project is implemented if and only if the reported surplus is positive. If individuals report truthfully, this leads to efficient project implementation. To ensure truthful reports, the mechanism calls for transfers equal to the expected externality an individual generates for the others with her reported valuation.[4] This forces individuals to take the expected surplus generated for the other players into account, and makes all individuals residual claimants of a value equal to their expected societal surplus (their own surplus, plus the expected surplus generate for others). Consequently, they should send the message resulting in the highest expected social surplus. Since the mechanism leads to efficient implementation decisions if all subjects report truthfully, this induces truthful reporting of all types. Because it combines incentive compatibility with efficiency and budget balance, the AGV provides the theoretical benchmark to compare other mechanisms to. If it is impossible to switch from a given mechanism to the most efficient mechanism, the AGV, a switch to any other (less efficient) mechanism is unlikely.

The SM mechanism is chosen for two reasons. First, it is a common mechanisms used in committee and small group decision making and therefore provides a natural benchmark for the empirical performance of the AGV. Second, the comparison between AGV and SM is the focus of the possibility theorem in Grüner and Koriyama (2012), such that we need it to reproduce the theoretical situation. The other two mechanisms, NSQ and RAND, are chosen to reproduce the comparisons studied in Myerson and Satterthwaite (1983), Schmitz (2002) and Segal and Whinston (2011).

[4] The translated instructions for the symmetric treatment, which include a table of the possible transfers, are in section A.3 in the appendix.

3.3 Treatments

In all treatments a uniform distribution over a type space with four possible valuations for the public project is used. We have one treatment with a symmetric and two treatments with skewed distributions. The two skewed treatments differ from the symmetric treatment in the valuation of a single type. The type spaces and distributions used are shown in table 1 below.

Table 1: Distribution of valuations for public project by treatment

Treatment	Valuations			
symmetric	-3	-1	1	3
right skewed (+7)	-3	-1	1	7
left skewed (-7)	-7	-1	1	3
probability	25%	25%	25%	25%

Notes: Probabilities are the same in all treatments.

Subjects draw a new private valuation for the project in each round and only participate in one treatment. The distribution of private valuations determines the expected payoff for the four mechanisms. In section 4 we provide the expected payoffs for all mechanisms in all three treatments and the tested theoretical predictions.

3.4 Procedures

The computerized experiments (zTree, Fischbacher (2007)) were conducted in the mLab of the University of Mannheim. Subjects were mostly undergraduate students from the University of Mannheim (recruitment through ORSEE, Greiner (2015)). Each session consisted of 18 rounds with random rematching among subjects.[5] All interactions were anonymous and subjects did not know who they were matched with in any round. To prevent income effects only one randomly selected round was paid in addition to a show up fee of 9€. Each round was equally likely to be chosen for payment and the selected round was identical for all subjects within a session. We conducted 9 sessions with 9 to 24 subjects, resulting in 150 participants (45 in the symmetric, 42 in the right skewed, 45 in the left-skewed treatment and 18 in a robustness check session we describe in section 5.5). 85 (57%) subjects were male and the average age of participants was 23 years.

The 18 rounds were split into three six-round blocks: two blocks of ex-ante rounds, rounds 1-12, followed by one block of ad-interim rounds, rounds 13-18. Subjects were aware of the existence of rounds 13-18 at the beginning of the experiment, but were only informed about the difference - the revelation of private valuations before the mechanism choice in the ad-interim rounds - after round 12. In all treatments, subjects made each of the six possible binary mechanism choices once in each block, yielding three choices for each comparison. The order of the pairwise comparisons was randomized within each block and between sessions. Additionally for each binary choice the order of the two mechanisms on the

[5] In sessions with 18 or more participants, subjects were split in two matching groups and could only meet subjects within their own matching group.

screens of the subjects was randomized between the three blocks. In the next section we state theoretical predictions for all treatments.

4 Theoretical predictions

To derive the theoretical predictions for our setting, we assume risk-neutrality and rational behavior in the second stage. Under these assumptions, the AGV is always efficient, and the predictions 2, 4 and 5 depend on this efficiency. For these results to hold without further qualification, the AGV should be ex-post efficient in all distributions, both in the ex ante and ad-interim rounds:

Prediction 1. *The AGV is the most efficient of the four mechanisms.*

In the ex-ante rounds a rational, risk-neutral agent should consider the Bayes-Nash equilibrium of each mechanism and select the mechanism with the highest expected payoff. The payoff maximizing mechanism depends on the possible private valuations (and their probability distribution, which is common in all treatments) and therefore on the treatment.

Table 2 below displays the preference ordering of mechanisms in the ex-ante rounds for each treatment.[6] Because the AGV is the only efficient mechanism, it yields the largest expected payoff in all treatments. In the symmetric treatment a risk-neutral subject should prefer the SM mechanism over NSQ and RAND. For the comparisons between mechanisms with the same expected payoff, e.g. NSQ and RAND in the symmetric treatment, no prediction can be made for risk-neutral agents. However, a small amount of risk aversion would imply a strict preference for NSQ.

Table 2: Predicted mechanism choices (ex ante)

Treatment	Ordering of mechanisms						
symmetric	AGV	$\succ$	SM	$\succ$	NSQ	$\sim$	RAND
right skewed (+7)	AGV	$\succ$	SM	$\succ$	RAND	$\succ$	NSQ
left skewed (-7)	AGV	$\succ$	SM	$\succ$	NSQ	$\succ$	RAND

Notes: $\succ$ and $\sim$ indicate the preferences ordering of the four mechanisms for a risk-neutral subject. The ordering of mechanisms corresponds to their expected payoffs given the respective treatment.

The relative advantage of the AGV over the SM, measured in the gain in expected payoff, is much larger in the two skewed treatments than in the symmetric treatment. In the symmetric treatment the AGV yields a 6% higher expected payoff than the next best mechanism (SM). This difference is 16% in the right-skewed treatment and it is 81% in the left-skewed treatment.[7]

By definition, ex ante all subjects are equal. Therefore it follows that the payoff maximizing mechanism for each subject is also maximizing the expected group surplus. Without private information, payoff

[6] The calculations for the AGV and for the SM mechanism assume truthful valuation reports (AGV) and sincere voting (SM), both in accordance with their respect Bayes-Nash equilibria. All calculations are in the appendix.

[7] In the symmetric treatment the ex ante expected payoff from the AGV mechanism is 0.53125€, while the SM has an expected payoff of 0.5€, NSQ and RAND both yield an expected payoff of 0. In the right-skewed treatment the expected payoffs are 1.452125€ for the AGV, 1.25€ for SM, 1€ for RAND and 0€ for the NSQ mechanism. In the left-skewed treatment the expected value for AGV and SM is still positive, 0.453125€ (AGV) and 0.25€ (SM), while the expected payoff for the NSQ mechanism remains at 0 and actually is negative, -1€, for RAND.

maximization should induce subjects to choose the most efficient mechanism, in which case the AGV and SM mechanisms should be preferred over NSQ and RAND. While the AGV should be prefered over SM if the Bayes-Nash equilibrium is played, but can depend on the realized efficiency otherwise.

Prediction 2. *Without private information, all individuals prefer the AGV and the SM over the NSQ and the RAND mechanism.*

In the ad-interim rounds subjects should consider the expected value of each mechanisms given their valuation. Therefore, an individual with a negative valuation of the public project should choose the mechanism with the lowest implementation probability (given the strategies played in the next stage). From this observation the Myerson and Satterthwaite impossibility theorem directly follows. In our setting the NSQ has a zero probability of implementation, it therefore dominates all other options for individuals with a negative project valuation.

Prediction 3. *With private information, individuals with a negative valuation prefer the NSQ over all other mechanisms.*

Table 3 shows the order of the expected payoffs in the ad-interim rounds per treatment and valuation, again assuming the Bayes-Nash equilibrium is played.

Table 3: Predicted mechanism choices (ad interim)

Treatment	Valuation	Ordering of mechanisms						
symmetric	3	AGV	≻	SM	≻	RAND	≻	NSQ
	1	AGV	∼	SM	≻	RAND	≻	NSQ
	−1	NSQ	≻	SM	∼	AGV	≻	RAND
	−3	NSQ	≻	AGV	≻	SM	≻	RAND
right skewed	7	AGV	≻	SM	≻	RAND	≻	NSQ
	1	AGV	≻	SM	≻	RAND	≻	NSQ
	−1	NSQ	≻	SM	≻	AGV	≻	RAND
	−3	NSQ	≻	SM	≻	AGV	≻	RAND
left skewed	3	SM	≻	AGV	≻	RAND	≻	NSQ
	1	SM	≻	AGV	≻	RAND	≻	NSQ
	−1	NSQ	≻	AGV	≻	SM	≻	RAND
	−7	NSQ	≻	AGV	≻	SM	≻	RAND

Notes: ≻ and ∼ indicate the preferences ordering of the four mechanisms for a risk-neutral subject. The ordering of mechanisms corresponds to their expected payoffs given the respective treatment and valuation.

Schmitz (2002) and Segal and Whinston (2011) show that by replacing the safe outside option with riskier ones, the impossibility problem of prediction 3 can be overcome. In our experiment this translates to a the prediction that the AGV should be preferred over RAND, even with private information. Similarly, since with a three-person group and the chosen distributions the SM mechanism is much more efficient than the RAND mechanism, all subjects should choose the SM over the RAND mechanism.

Prediction 4. *With private information*

(i) all individuals prefer the AGV over the RAND mechanism and

(ii) all individuals prefer the SM over the RAND mechanism.

Grüner and Koriyama (2012) demonstrate that individuals can prefer the AGV over the SM, even with a negative valuation, as long as some conditions are met. Mainly because we have odd numbered groups, these conditions do not always hold in our setting. However, their results translate to the following qualified prediction:

Prediction 5. *In the symmetric treatment*

(i) subjects with a private valuation of -3 or +3 strictly prefer the AGV over the SM mechanism,

(ii) subjects with a private valuation of -1 or +1 are indifferent between the AGV and the SM.

In the skewed treatments

(iii) subjects with a private valuation of -3 or -1 (right-skewed treatment) and 3 or 1 (left-skewed treatment), strictly prefer the SM over the AGV,

(iv) while all other subjects prefer the AGV over the SM mechanism.

Additionally we test whether subjects prefer the theoretical optimal AGV mechanism over other, better known mechanisms. If subjects' choices in the ex-ante rounds are sensitive to expected payoff differences, the AGV mechanism should be chosen more often in the skewed treatments than in the symmetric treatment. Furthermore, the AGV transfers in the right-skewed treatment are usually paid by subjects reporting extremely high valuations. This "taxing the winner" property could be seen as fair by subjects, since an individual benefiting strongly from project implementation has to compensate other group members. In the left-skewed treatment this 'tax' is levied from the loser(s). If such fairness concerns play a role in mechanism selection, the AGV should be more desirable in the right skewed than the left-skewed treatment. However, we do not believe that the mechanism choices in the ad-interim rounds will be affected, since the known private valuation for the project should make the own payoff consequences of the mechanism choice more focal and therefore fairness concerns might be less relevant.

Prediction 6. *The AGV mechanism is chosen more often*

(i) in the left and right-skewed treatment than in the symmetric treatment due to efficiency differences,

(ii) in the right-skewed treatment than in the left-skewed treatment, since subjects prefer "winners" rather than the "losers" of the project implementation to pay transfers.

(iii) Both effects are more pronounced in the ex-ante rounds then in the ad-interim rounds.

5 Results

We present the results in the same order as the predictions, starting with the realized efficiency of the AGV and the SM mechanisms before analyzing subjects' ex-ante choices in more detail. Next we present our findings on the Myerson-Satterthwaite impossibility theorem and then discuss the ad-interim mechanism choices before concluding with an analysis of subjects' behavior in stage two of the AGV (value reports) and the SM mechanism (voting).

5.1 Realized surplus

Whether the AGV is actually more efficient than the other mechanisms depends on subjects' behavior and especially on the question whether they truthfully report their type (AGV) and vote sincerely (SM mechanism). Theoretically the AGV is incentive compatible, such that truthful reporting should result in equilibrium. However, we cannot assume perfectly rational expected-value maximization. If subjects misreport their valuation it is not clear whether the AGV actually generates the largest surplus.

We do not use the actual surplus generated in the lab as our measure of efficiency, since this measure is strongly influenced by the realization of private valuations as well as the mechanism choices by the random dictator. Instead, we use the observed distribution of reports/votes made by subjects with a specific type in a treatment, as the behavioral strategy for that type in that treatment. We calculate project implementation probabilities for all permutations of the type vector given these strategies. The displayed surplus (in €) is the expected value of the group surplus in the mechanisms given these strategies and the probability that a particular permutation of the type vector occurs. It is therefore the surplus that would have realized if all possible combinations of private valuations occurred with their expected probabilities and all individuals with the same type used the observed reporting/voting strategy.

Table 4 below shows the Bayes-Nash equilibrium surplus and the realized group surplus for the AGV or SM mechanisms in the ex-ante rounds in all treatments.[8] The theoretical surplus of each mechanism is reported in columns 2 (AGV) and 5 (SM), the realized surplus in columns 3 and 6, and columns 4 and 7 show the absolute (and relative) surplus loss compared to the theoretically benchmark.

Table 4: Theoretical and realized group surplus with AGV and SM (ex ante)

	AGV Group surplus			SM Group surplus		
Treatment	theoretical	realized	lost (%)	theoretical	realized	lost (%)
symmetric	1.59	1.18	0.41 (26%)	1.50	1.34	0.16 (11%)
right skewed (+7)	4.36	3.84	0.51 (12%)	3.75	3.68	0.07 (2%)
left skewed (-7)	1.36	0.93	0.43 (32%)	0.75	0.66	0.09 (13%)

The results in table 4 clearly show that the AGV generates a higher expected surplus than the SM mechanism in theory. However, the table also illustrates that neither mechanism reaches its full theoretical efficiency level. In the symmetric treatment the surplus loss of the AGV is so large that the efficiency ordering is reversed. The AGV mechanism only realizes an expected group surplus of 1.18, while SM reaches a surplus of 1.34. In the two skewed treatments the AGV is more efficient than the SM mechanism, but the advantage is smaller than predicted.

These results only partially support prediction 1. Both the AGV and the SM do not perform as well as predicted. The efficiency loss in the AGV is larger than in SM in all three treatments. The AGV is, ex ante, the most efficient mechanism only in the two skewed treatments. In the symmetric treatment the SM mechanism is theoretically very close to optimal, and it slightly outperforms the AGV in terms of efficiency in this setting. While we discuss the reasons for the lower surplus of the AGV mechanism in

[8] We concentrate on the ex-ante results, because we have more observations in these rounds than in the ad-interim rounds, which makes the results more reliable. Although they are noisier, results for the ad-interim rounds are qualitatively similar.

detail at the end of the results section, it is important to note that the valuation reports suggest that the loss is unlikely to be caused by a small number of confused subjects. Something more systematic seems to be going on.

5.2 Ex-ante choices

In this section we analyze subjects' mechanism choices in the ex-ante rounds 1-12. We concentrate on the results of the symmetric treatment. Since most results are not qualitatively different between treatments, we only discuss comparisons between mechanisms in the skewed treatments that are particularly interesting.

The results of all six binary comparisons in the symmetric treatment are shown by the histograms in figure 1. In five cases there is a clear majority for one mechanism: AGV and SM are clearly preferred to the NSQ and the RAND mechanism and SM is generally chosen over AGV.[9] There is no clear preference in the choice between the NSQ and RAND mechanism. Subjects are almost evenly split between these mechanisms and a binomial test does not reject a 50:50 split (p-value 0.46). This indifference is not surprising given the identical expected payoff from both mechanisms. The split between RAND and NSQ seems to indicate risk neutrality of our subjects.

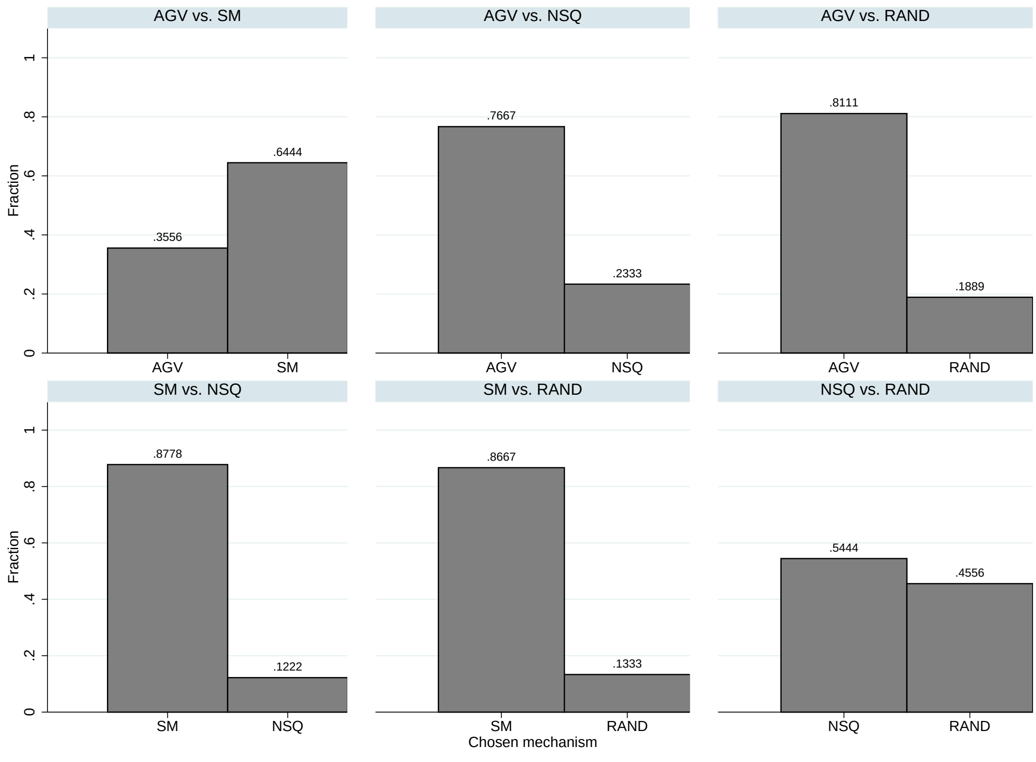

Figure 1: Ex-ante binary choices (symmetric treatment)

If we compare the predictions stated in table 2 with the results in figure 1, we see only one deviation. Only in the choice between AGV and SM the majority of subjects does not prefer the mechanism with the larger expected payoff in theory. However, as we have shown above, within the symmetric treatment

[9] Binomial tests confirm a significant difference from a 50:50 split for all comparisons (p-values < 0.01).

the SM mechanism generates more surplus then the AGV mechanism. Therefore, a majority of subjects prefers the mechanism with the largest expected payoff in all six comparisons.[10]

Table 5 below shows for all comparisons and treatments the mechanism selected by a majority of subjects in the ex-ante rounds. The prediction that subjects select the most efficient mechanism corresponds to completely unanimous choices in every comparison. While this is not the case, in many comparisons one mechanism is preferred by a large majority. Although the predictions concentrate on individual choices, we present the median choice in this table. Since we are dealing with binary choices and about 80% of the mechanism rankings obtained from individual binary comparisons within a block of 6 rounds satisfy strict transversality, this aggregation is consistent with the preferences of our 'average' subject.

The modal stated preference goes in the predicted direction for all, but two comparisons. In the symmetric and the right-skewed treatments the AGV is not preferred to the SM mechanism.

Table 5: Mechanisms chosen by a majority of subjects in the ex-ante rounds

Treatment	AGV vs. SM	AGV vs. NSQ	AGV vs. RAND	SM vs. NSQ	SM vs. RAND	NSQ vs. RAND
symmetric	SM**	AGV	AGV	SM	SM	NSQ ∽ RAND
right skewed (+7)	SM ∽ AGV*	AGV	AGV	SM	SM	RAND
left skewed (-7)	AGV	AGV	AGV	SM	SM	NSQ

Notes: The mechanism in each cell was chosen by the majority of subjects in the respective treatment. All results are aggregated over both comparisons (rounds 1-6 and 7-12). The number of observations for the three treatments are: 90 (symmetric), 84 (right skewed) and 90 (left skewed). Binomial tests reject a 50:50 split at the 99% level for all but two comparisons: NSQ vs. RAND in the symmetric treatment and AGV vs. SM in the right-skewed treatment. A * indicates that the majority choice is not in line with the theoretical efficiency prediction, ** indicates that the choice is in line with realized but not with theoretical efficiency.

We provide the results for the comparison between the AGV and the SM in all treatments in figure 2 below. In the symmetric (64%) and right-skewed treatment (58%) a majority chose the SM over the AGV mechanism. This ordering flips around for the left-skewed treatment, in which 70% prefer the AGV. This increase is in line with the increase of the relative advantage of the AGV over the SM mechanism.[11]

Comparing subjects' choices with the realized surplus, shows that a majority chooses the mechanism with the highest realized surplus in all comparisons, except in the right-skewed treatment for the comparison between AGV and SM. Therefore, we can conclude that the average mechanism choice of subjects is almost perfectly in line with the ordering predicted by realized efficiency. Since the theoretical predictions about efficiency has almost the same order as the realized efficiency, subjects generally prefer the theoretically most efficient mechanism in the ex-ante rounds, confirming prediction 2. Note that this means we can already reject all parts of prediction 6. Our subjects do not appear to prefer taxing winners over taxing losers, not even in the ex-ante rounds. Choices seem to follow realized expected value in the lab, rather then any form of other regarding preferences.

[10] Which of the two mechanisms is listed first seems to be without effect. We vary the order of comparisons between the two rounds of comparisons and between sessions, but there are no signs of order effects in any direction. The detailed results for all comparisons in the ex-ante rounds are in the appendix in table 10.

[11] More subjects prefer the AGV over the SM mechanism in the left-skewed treatment than in the two other treatments (Mann-Whitney-U (MWU) tests, p-values < 0.01) while the difference is not significant between the symmetric and the right-skewed treatment (MWU test, p-value 0.41). For the symmetric and left-skewed treatments a binomial test rejects a 50:50 split (p-values < 0.01). The 50:50 split cannot be rejected in the right-skewed treatment (p-value 0.16).

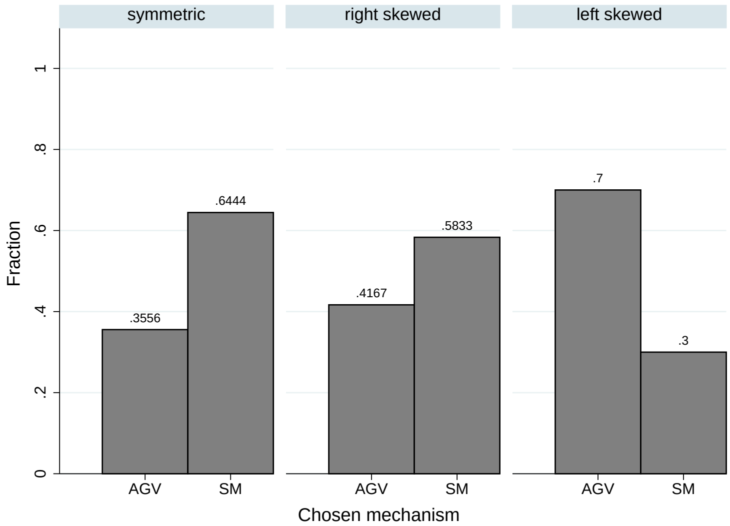

Figure 2: Ex-ante choices between AGV and SM mechanism (by treatment)

5.3 Impossibility results

The Myerson-Satterthwaitte theorem predicts that no (efficient) mechanism is unanimously preferred over the Non-implementation Status Quo. Figure 3 shows all choices made between NSQ and the other mechanisms in the symmetric treatment.[12] In the top (bottom) row the revealed preferences for the ex-ante (ad-interim) comparisons are shown. For each decision the figure first shows the choices for subjects with a positive and then for those with a negative valuation. Since subjects do not know their valuation when making the mechanism choice in the ex-ante rounds (top row), the choices of the subjects with positive and negative valuations are statistically almost indistinguishable.[13]

The expected choice reversal can be seen by comparing the graphs in each column. The change in choices is obvious in all three comparisons: while the AGV and SM are preferred over the NSQ in the ex-ante rounds (top, columns one to four) and the RAND and NSQ mechanism are about equally likely to be chosen by all subjects (top, columns five and six). These choices reverse for virtually all subjects with a negative valuation in the ad-interim rounds. In our experiment subjects with a negative valuation prefer the NSQ over the other mechanism (bottom, columns two, four and six).[14] These results confirm prediction 3: many individuals would prefer not to participate in the efficient group choice mechanism, making unanimous agreement virtually impossible.

The effect of private information can be seen very clearly in the comparison between the RAND and NSQ mechanism (columns five and six). With a symmetric value distribution both mechanisms have a zero expected payoff ex ante and the choices of subjects seem to indicate this ‘indifference’. With private information, however, subjects’ revealed preferences are almost perfectly correlated with

[12] Because we did not find significant differences between the first and second block of ex-ante mechanism choices, we pool these choices in the analysis. Results for the other treatments are very similar.

[13] Of the 9 comparisons (three per treatment) only in the right-skewed treatment for the choice between the NSQ and RAND we find a statistically different mean choice between subjects with a positive and subjects with a negative valuation (p-value of 0.045, MWU test). Since subjects were unaware of their valuation when they made the choice, this difference has to be random. All other comparisons do not yield a significant difference (p-values > 0.10, MWU).

[14] MWU tests show that significantly more subjects with a negative valuation chose the NSQ mechanism in all three comparisons in the ad-interim than in the ex-ante rounds (p-values < 0.01).

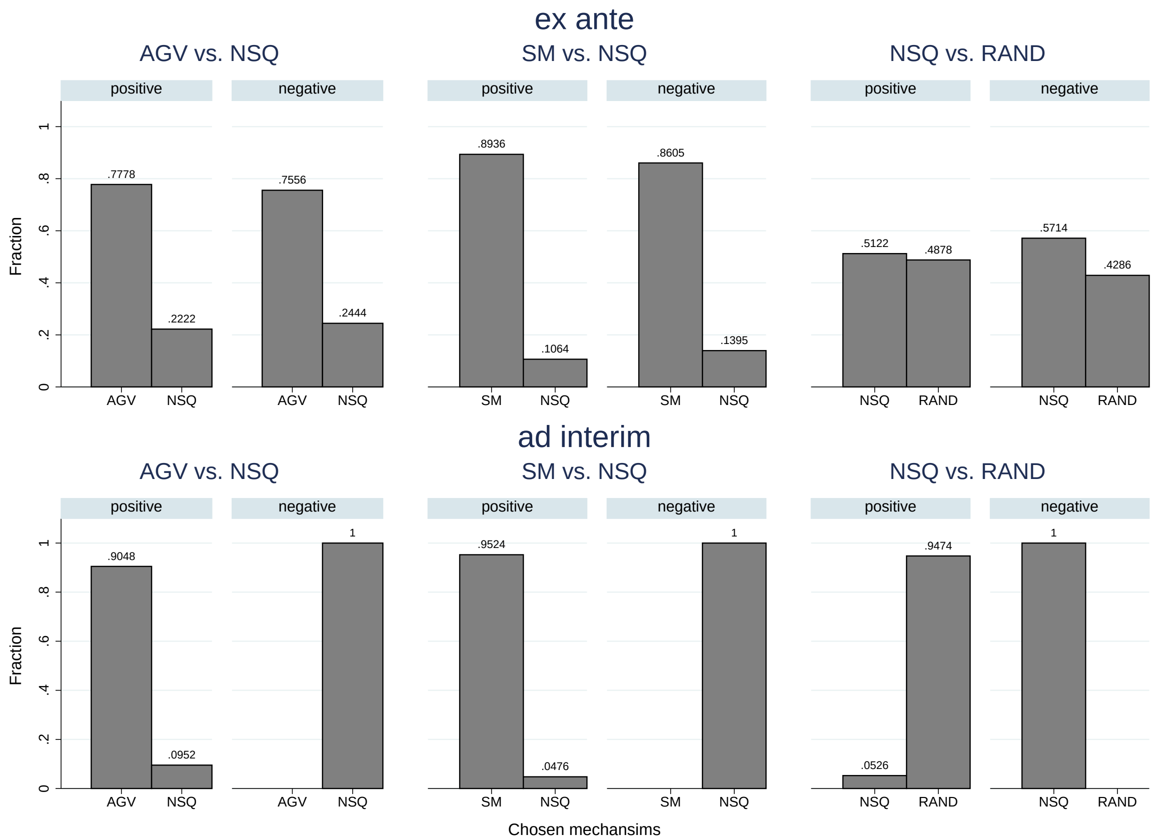

Figure 3: Mechanism choice by positive/negative private valuation (symmetric treatment)

valuations: NSQ is preferred by subjects with a negative valuation and RAND by those with a positive valuation. Even complete randomness is acceptable, as long as it increases own income (at least in the lab). Unlike the behavior observed by Engelmann and Grüner (2013), in our setting social or efficiency concerns seem not to play a role for subjects' mechanism choices. Our subjects appear almost perfectly rational and narrowly self-interested with respect to their mechanism choice.

5.4 Ad-interim choices

We now turn to the results for the other ad-interim comparisons. Prediction 4 states that all subjects should prefer the AGV and the SM over the RAND mechanism, regardless of their valuation. Our results are qualitatively equivalent for the binary comparisons of the AGV vs. the RAND mechanism and the SM vs. the RAND mechanism. In the interest of space we only report the former in figure 4.[15] It shows that at the aggregate level the AGV is clearly preferred over the RAND mechanism. As was predicted by Schmitz (2002) and Segal and Whinston (2011), the Myerson-Satterthwaite impossibility theorem can be overcome if the outside option is a risky rather then a save status quo.[16]

The claim in prediction 4 is actually even stronger than a preference for the AGV over RAND on the aggregate level, since it predicts a preference for the AGV by all types. This stronger prediction is also confirmed by our data, with one minor exception. In the left-skewed treatment the AGV and RAND

[15] We show the results of all ad-interim choices separately for treatments and private valuations in table 11 in the appendix.
[16] Binomial tests reject an equal distribution in all treatments (p-values < 0.01).

mechanism are equally often preferred by individuals with type +3: exactly 50% chose the AGV. In all other treatments and for all other valuations, the AGV receives at least 60% of all votes and in most cases it is chosen by a larger margin.[17] Our results therefore clearly confirm prediction 4.

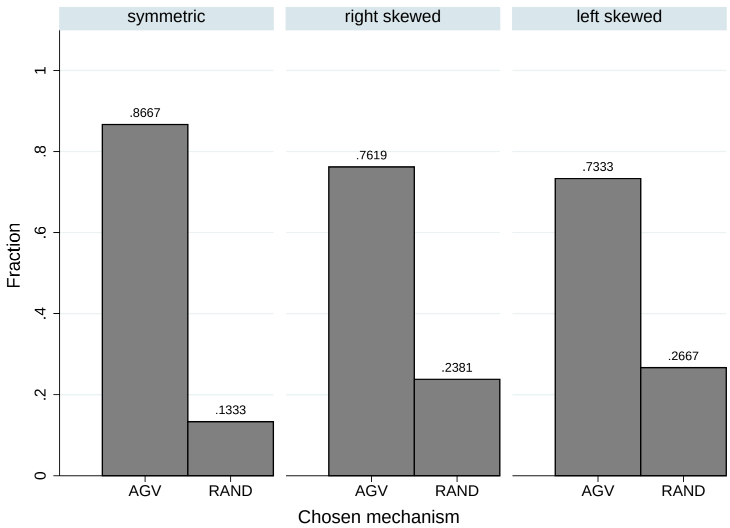

Figure 4: Ad-interim choices between AGV and RAND mechanism (by treatment)

The revealed preferences of subjects for the ad-interim choice between the AGV and the SM mechanism are shown in figure 5 per treatment and type. Although the statements made in prediction 5 are the most sensitive to the small number of observations in some cells, the comparative statics are largely borne out by the data. In the symmetric treatment, preference for the AGV is more pronounced for the types -3 and 3 then for the types -1 and 1. Similarly, the preference for the AGV seems to increase with the valuation in the right-skewed treatment, and decreases with valuation in the left-skewed treatment. The only exception being the -3 type in the right-skewed treatment.

While the AGV mechanism is preferred by all subjects with the most extreme private valuations (+7 and -7), subjects with a valuation of +/-1 are almost evenly split between the mechanisms. The clear preference for the AGV of subjects with an extreme valuation is not only in line with the prediction, it is also an indication that subjects understood that in the AGV mechanism an extreme valuation report is equivalent to certain implementation (+7), respectively a veto against implementation (-7). Since subjects in the skewed treatments like the AGV mechanism less than predicted, prediction 5 is not fully confirmed.

The largest deviations from the prediction seems to stem from the fact that the AGV is not always as efficient in the lab as predicted by theory. This was caused by subjects' second stage reporting (AGV) and voting (SM) strategies, which are analyzed in the next section.

[17] While the results appear clearly in the appropriate graphs, formal tests cannot confirm the results at the common significance levels for the different private valuations, since the low number of cases (8-15 per valuation and treatment) results in relatively high p-values even if 60% or more selected the AGV mechanism.

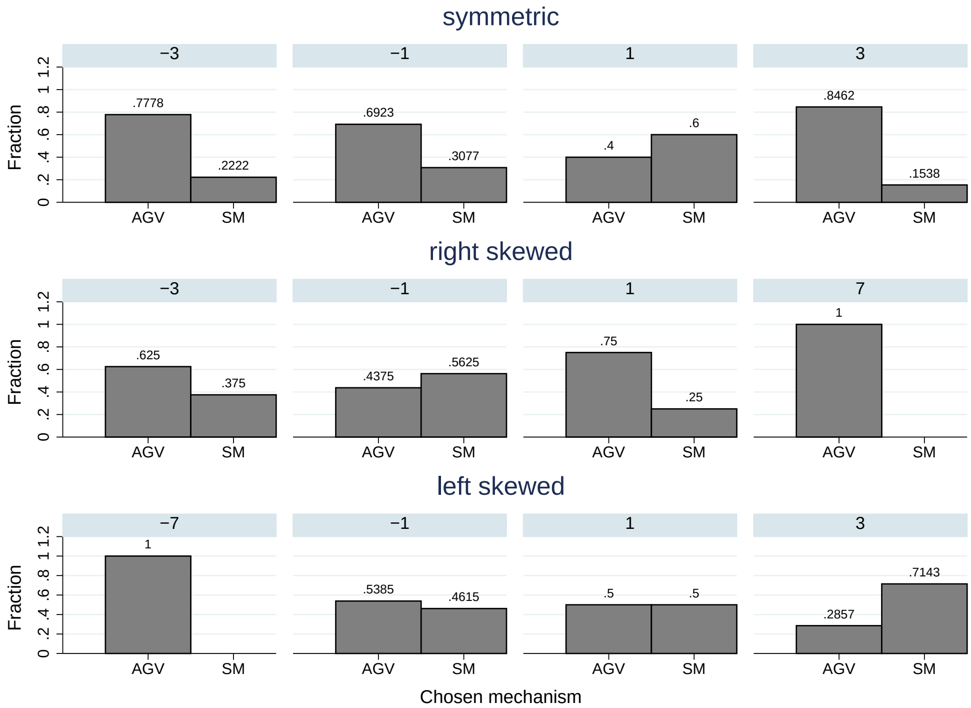

Figure 5: Ad-interim choices between AGV and SM mechanism (by treatment and valuation)

5.5 Voting and reporting behavior

In section 5.1 we showed that both the SM and AGV mechanism perform below theoretical expectations. In this section we use the individual reports (AGV) and votes (SM) to analyze the reasons for this efficiency loss.

In the AGV truthful reporting forms a Bayes-Nash equilibrium. To make sure that our subjects were aware of this, our subjects were told that if the other subjects report truthfully, it maximizes their expected payoff to report their true valuation as well. However, there is no guarantee that subjects understand and act in accordance with those statements, let alone that they believe others do. Table 6 shows three tables, one for each treatment, with the reported valuations as a function of private valuations for the ex-ante rounds in which the AGV mechanism was used.

If all subjects reported their true valuation all entries should be on the main diagonal of the tables. However, as all the off-diagonal elements show, many subjects misreport. We consider two types of false reports separately. Over- or under-reporting is defined as sending a report that is more (or less) extreme than the subjects' true valuation but has the same sign. This kind of reporting can be caused by the desire to ensure (non-)implementation or avoid paying transfers. Misreporting the sign of the valuation, e.g. reporting +1 with a valuation of -1, is of a different caliber. There is no reason to misreport the sign of the valuation if a subject is maximizing her expected payoff. A subject with a negative valuation should not want the project to be implemented. By reporting a positive valuation she increases the probability of implementation, which can never be optimal. Remember that no implementation results in a zero payoff from the project for all group members, independently of the valuation. The same argument, with reversed signs, holds for positive valuations. Therefore, while over- or under-reporting can be rationalized (at least to some extent) by small mistakes, misreporting the sign of the valuation cannot.

Table 6: AGV reports (ex ante)

(a) symmetric treatment

true	reported valuations				
valuations	3	1	−1	−3	Total
3	41	7	0	0	48
1	16	28	1	0	45
−1	1	3	28	16	48
−3	4	6	7	25	42
Total	62	44	36	41	183

(b) right-skewed treatment

true	reported valuations				
valuations	7	1	−1	−3	Total
7	43	1	0	0	44
1	13	21	1	0	45
−1	3	8	11	24	46
−3	6	5	5	37	53
Total	65	43	17	61	183

(c) left-skewed treatment

true	reported valuations				
valuations	3	1	−1	−7	Total
3	35	10	1	0	46
1	23	36	0	0	59
−1	1	5	35	14	55
−7	4	3	2	53	62
Total	63	54	38	67	222

Table 6b shows that the reports that involve an incorrect sign in the right-skewed treatment are concentrated on subjects with a negative valuation. Only one of the false reports of subjects with a positive valuation misreports the sign. In striking contrast, 22 (43%) of subjects' reports with a negative valuation include an incorrect sign. This pattern is not limited to the right-skewed treatment, see tables 6a and 6c, or the ex-ante rounds (not reported).This pattern is not caused by a few individuals. In all three treatments about 30% of reports differ from true valuations and 25% of subjects incorrectly report the sign of their valuation at least once. The 30% misreported values are spread over a large share of the subject population, such that we believe that confusion is not the main reason for the reports.

These averages are also quite stable over rounds. E.g. conditioning on the first 6, first 12 or last 6 periods (ad-interim choices), yields similar percentages of misreports. Learning either does not happen, or again, the underlying behavior is not driven by confusion. However, there does appear to be a significant difference between subjects that select the AGV and those who favor the alternative mechanism. The first group is statistically less likely to misreport the sign of their valuation (Chi-Square test, p-value < 0.01, using AGV reports for all ex-ante rounds). However, sign misreporting takes place in both groups.

Given these results, we ran an additional session that eliminates most reasons for misreporting as a robustness check. Again, the only difference between this treatments and the others is the type space. Private valuations were drawn from the set {-3 €, -2 €, -1 €, 7 €}. These valuations result in identical transfers and implementation probabilities for all negative reports. Therefore under- or over-reporting has no effect on payoffs. Furthermore, all valuations had a unique absolute value, decreasing the probabilities of accidentally selecting -1 rather than +1 and vice versa. The AGV reports in the ex-ante rounds of this session are shown in table 7.

While we still see reports with an incorrect sign, these are less frequent than could be expected if the subjects played a similar strategy as in the other treatments. Some of the misreported signs are likely to have been mistakes. In this session all reports of a negative value have the same effect on the implementation probability of the project and result in identical transfers. The fraction of under- and over-reporting subjects with a negative valuation seems to indicate subjects understood this. Given these observations and the fact that in all sessions private valuations are random, change from round to round, and the experimental screens showed the sign of the valuation (both the + and the - sign), we have no explanation for the pattern we find.

Table 7: AGV reports (ex ante) in the robustness session

true valuations	reported valuations 7	−1	−2	−3	Total
7	19	1	1	0	21
−1	1	9	4	11	25
−2	1	0	8	8	17
−3	0	0	0	15	15
Total	21	10	13	34	78

Notes: As in the other treatments the probability of each value is 25%.

In order to approximate the loss in expected group surplus that is caused by the two different types of false reports we repeated the calculations of table 4 after excluding over-and under-reporting, and misreported signs respectively. Table 8 shows both the original (columns 4-5) and the adjusted results. Comparing the adjusted efficiency without misreported signs (columns 6-7) with the adjusted efficiency without under- and over-reporting (columns 8-9) shows that most efficiency is lost through the falsely reported signs. Depending on the treatment between 11% (right-skewed treatment) and 23% (symmetric treatment) of the theoretical group surplus is lost due to valuation reports with an incorrect sign.[18]

Table 8: Group surplus loss in the AGV under different types of false reports (ex ante)

Treatment	All reports correct	All reports		Effect of over- / under-reports		Effect of sign misreports	
	theoretical	realized	lost (%)	adjusted	lost (%)	adjusted	lost (%)
symmetric	1.59	1.18	0.41 (26%)	1.46	0.13 (8%)	1.22	0.37 (23%)
right skewed (+7)	4.36	3.84	0.51 (12%)	4.12	0.24 (6%)	3.88	0.48 (11%)
left skewed (-7)	1.36	0.93	0.43 (32%)	1.12	0.24 (18%)	1.08	0.28 (21%)

Notes: The columns for *Effect of over- / under-reports* remove all reports with a false sign from the behavioral strategy of the subjects. Similarly, in the columns *Effect of sign misreports* all reports that over- or under-report the true value are not considered. The *lost* columns state the absolute (relative) group surplus loss with regard to the theoretical group surplus under truthful reporting.

Unlike the reports in the AGV mechanism, the voting behavior of subjects is very close to theoretical predictions and almost perfectly rational. For all treatments and private valuations, subjects vote according to their valuations in 89% to 100% of the rounds. There is no pattern of incorrect votes in relation to the sign of the valuation. Subjects are about equally unlikely to vote against their private valuations for positive and negative valuations.

[18] The sum of the surplus from both types of false reports does not sum up to the difference between the theoretical and realized group surplus, since both types of misreports can occur together and thus interact in the realization of actual efficiency. The total surplus loss surplus due to the misreporting can thus be higher or lower than sum of the separate calculations.

The different rates of rational reporting/voting drive the relatively small realized efficiency advantage of the AGV over the SM mechanism. Especially the incorrectly reported signs result in large efficiency losses of the AGV. The higher percentage of misreports in the AGV compared to the non-sincere votes in the SM mechanism can be partially explained by larger familiarity of subjects with the SM. However, the systematic difference in the reporting behavior of individuals with positive and negative types is unlikely to be explained by mistakes alone. Up to this point we have no explanation for this difference.

6 Conclusion

This paper presents the results of a first experimental study on the effects of private information and outside options on mechanism selections in a group decision experiment. Our results on the ex-ante preferences in all treatments demonstrate that subjects are aware of the efficiency differences between the mechanisms. In almost all cases a clear majority of subjects selects the mechanism that is more efficient in the lab. Not too surprisingly, if the difference in efficiency between two mechanisms is small, results are less clear.

The behavior in the ad-interim rounds also largely confirms related theoretical predictions. As the Myerson-Satterthwaite impossibility theorem predicts, the same subjects that prefer the efficient AGV mechanism ex ante, suddenly opt for the complete inertia of the Non-implementation Status Quo after learning their private valuation. Similarly, most subjects prefer the AGV over flipping a coin (RAND) even after learning their private valuation, as predicted by Schmitz (2002) and Segal and Whinston (2011). Our data is less clear about the predictions made by Grüner and Koriyama (2012) regarding the choice between AGV and SM. Although the overall pattern seems to conform to the theoretical predictions, efficiency differences between these mechanisms are small and clear majorities for either AGV or SM often do not exists.

These results highlight the importance of participation constraints in the design of institutions. In many situations it is impossible to set an efficient decision rule ex ante. Also it might not be possible to establish an efficient mechanism through a decentralized and completely voluntary procedure ad interim. This combined impossibility touches upon one of the most fundamental questions in mechanism design, political economy, and more generally political philosophy. Since participation constraints already create problems in the small groups in our experiment, the difficulties of negotiating a public project on the scale of a nation would seem close to unsurmountable if unanimity (or completely voluntary participation by all parties) is required. A group that is stuck in an inefficient mechanism might require an outside influence or coercive power to break away from the status quo. Centralized organizations with an amount of coercive power, like the state or the company, are able to force participation and thus avoid these problems. In doing so, these organizations allow participants to bundle individual projects and reforms and take them away from purely decentralized mechanisms like open markets. Often the gains in efficiency from extra investment in common projects are large enough to compensate participants for their involvement in projects that are not individually rational to them. In this sense, our findings give one reason for the existence of states. Although a centralized state might not be as efficient in dealing with incentive constraints as the market, it does make dealing with the participation constraints on individual projects a lot easier.

Because our subjects play all mechanisms, we can compare the relative efficiency of the AGV and SM mechanism on the same group of subjects. The SM mechanism is almost as efficient in the lab as theoretical calculations with rational self-interested agents predict. The AGV is perfectly efficient in theory, but loses a lot of its efficiency in practice due to false reports. In our experimental results we find a puzzling pattern in the reporting strategy used by subjects in the AGV. While both subjects with positive and negative valuations sometimes over- or under-report their valuation, only subjects with a negative valuation systematically misreport the sign of their valuation. These valuation reports with an incorrect sign account for most of the efficiency loss of the AGV in our experiment. Interestingly, this pattern is present in all treatments and does not seem to be driven by the behavior of a few individuals. Subjects in our experiment gather some experience in the AGV, but not too much. Depending on the random allocation of private valuations, a subject might never experience the real advantage of the AGV over the much more common SM mechanism. In order to have a "fair" comparison, it might be necessary to provide subjects with more opportunities to learn how the AGV actually works and to demonstrate why the mechanism is more efficient. Given that we do not familiarize our subjects with the AGV in this manner, it is actually quite remarkable how often the AGV is chosen. Still our findings indicate that there is room for further research in the area of efficient mechanism implementation.

Our setup allows us to vary individual participation constraints and to apply strong within subject tests of theoretical predictions. The crispness of the results obtained is a clear indication of the strength of this methodological setup. We believe the method by which participation constraints are implemented, measured and varied in this experiment could be fruitfully applied to experimentally investigate other questions surrounding participation constraints.

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A Appendix

A.1 Derivation of predictions

A.1.1 Predictions 1 and 2

Note that all mechanisms generate as much surplus as is generated by the common investment, as the rest of the (experimental) budget is ex-post balanced. From the four mechanisms, the AGV mechanism is the only mechanism that implements (in Bayes-Nash equilibrium) the project if and only if the generated surplus is larger than 0. The other mechanisms all have an efficiency loss from wrong implementation, or wrong non-implementations and therefore are less efficient in expectation. These differences in efficiency imply prediction 1 and the preference of individuals without private information for the AGV over NSQ and RAND mechanisms in prediction 2. The SM mechanism implements if and only if at least two people vote in favor. If we assume that individuals vote in favor if they have a positive valuation and against if it they have a negative valuation, we can see that when the loss of efficiency in implementation occurs. In the symmetric treatment this happens in two cases (type vectors {-1,-1,3} and {1,1,-3}), both of which cost 1€ and occur with a probability of 0.046875, such that the expected loss of the SM mechanism relative to the efficient outcome is 0.09€, or 5.88% of the maximum efficiency.

In the right-skewed treatment with the +7 value there are four cases of inefficient implementation, type vectors {-3,-3,7}, {-3,-1,7}, {-3,1,1} and {-1,-1,7}, occurring with probabilities 0.046875, 0.09375, 0.046875 and 0.046875 respectively. The expected loss is 0.61€, or 13.98% of maximum efficiency. In the left-skewed treatment with the -7 value there are four cases of inefficient implementation, type vectors {1,1,-7}, {3,1,-7}, {3,-1-,1} and {3,3,-7}, occurring with probabilities 0.046875, 0.09375, 0.046875 and 0.046875 respectively. The expected loss is also 0.61€, but this is 44.82% of maximum efficiency in this setting, since the maximum efficiency delivers a much lower surplus.

The RAND mechanism has a zero expected surplus for the symmetric treatment, a -1 expected surplus in the left-skewed treatment (-7), and a +1 expected surplus in the right-skewed treatment (+7). The loss of efficiency of the NSQ is a 100% always. Since the efficiency loss in the SM mechanism is always lower than the loss in the NSQ or RAND mechanism, this proves prediction 2.

A.1.2 Prediction 3

With known private values v_i, individuals can calculate their expected utility as a function of mechanism Γ:

$$E(U) = v_i * \Pr(\text{Y=1} \mid \Gamma = \text{M}).$$

With $Y = 1$ denoting implementation and $M \in \{\text{NSQ, RAND, AGV, SM}\}$. With a negative private value, v_i, the best choice is the one with lowest probability of implementation. Since $\Pr(\text{Y=1} \mid \Gamma = \text{NSQ}) = 0$, the NSQ (weakly) dominates all other mechanisms for these individuals.

A.1.3 Predictions 4 and 5

For the AGV assume that individuals report truthfully in the second stage when playing AGV, and similarly for SM vote in favor in case of positive valuation and against otherwise. Each individual should then choose the mechanism that maximizes her expected payoff, which for SM is as before:

$$E(U) = v_i * \Pr(\text{Y=1} \mid \Gamma = \text{M}).$$

In the AGV the expected payoff is additionally influenced by the expected transfer each individual has to pay. Since the individuals possess private information, this can be both positive or negative. It is straightforward, albeit somewhat tedious, to calculate the expected utility of each type for each of the three mechanisms in all treatments. The results are displayed in table 9 below.

Table 9: Expected utility by type and mechanism

	Mechanism				
	AGV			RAND	SM
type	symmetric	right skewed	left skewed	all treatments	
−7			−0.60417	−3.5	−1.75
−3	−0.6875	−1.16667		−1.5	−0.75
−1	−0.25	−0.27083	−0.14583	−0.5	−0.25
1	0.75	0.854167	0.760417	0.5	0.75
3	2.328125		1.885417	1.5	2.25
7		6.401042		3.5	5.25

Like it was shown more generally by Segal and Whinston (2014), no single type prefers to flip a coin over playing the AGV (or SM in this case). For the predictions of Grüner and Koriyama (2012) we have a slightly more qualified result. In the skewed treatments the types -3 and 3 prefer the SM mechanism while the other types {-7, -1, 1, 7} prefer the AGV mechanism. In the symmetric treatment the types -1 and 1 are indifferent, while the types -3 and 3 prefer AGV.

A.2 Further results - All choices

In table 10 the results for all binary comparisons in the ex-ante rounds (round 1: 1-6, round 2: 7-12) are shown. The mechanism stated in each cell is the mechanism chosen by a majority of subjects for the binary comparison in this column. E.g. the 69% in the row *'symmetric treatment, round 1'* in the third column *(AGV vs. SM)* mean that 69% of subjects chose the SM over the AGV mechanism (consequently 31% chose the AGV mechanism) in the first comparison of these mechanisms.

Table 10: Percentage of subjects that chose each mechanism in the ex-ante rounds

Treatment	# of subjects	Binary choice: AGV vs. SM	AGV vs. NSQ	AGV vs. RAND	SM vs. NSQ	SM vs. RAND	NSQ vs. RAND
symmetric							
round 1	45	SM (69%)	AGV (78%)	AGV (76%)	SM (89%)	SM (89%)	RAND (53%)
round 2	45	SM (60%)	AGV (76%)	AGV (87%)	SM (87%)	SM (84%)	NSQ (62%)
right skewed (+7)							
round 1	42	SM (55%)	AGV (81%)	AGV (79%)	SM (90%)	SM (88%)	RAND (74%)
round 2	42	SM (62%)	AGV (83%)	AGV (90%)	SM (90%)	SM (88%)	RAND (69%)
left skewed (-7)							
round 1	45	AGV (69%)	AGV (78%)	AGV (82%)	SM (73%)	SM (93%)	NSQ (60%)
round 2	45	AGV (71%)	AGV (73%)	AGV (82%)	SM (60%)	SM (93%)	NSQ (69%)

Notes: The mechanism named in each cell was chosen by the majority of subjects (percentage). Each subject made a choice in each round, therefore the number of subjects for the three treatments are: 45 (symmetric), 42 (right skewed) and 45 (left skewed).

In table 11 the mechanism that was chosen by the majority of subjects for each binary comparison in the ad-interim round of all treatments is listed. The table reports the proportions of subjects for each valuation, e.g. the cell in the row *'symmetric, 3'* and second column *(AGV vs. SM)* states that 11 of 13 subjects with a valuation of +3 chose the AGV mechanism over the SM mechanism (consequently 2 of 13 subjects selected the SM mechanism).

Table 11: Proportion of subjects that chose each mechanism in the ad-interim rounds

Treatment / Valuation	Binary choice: AGV vs. SM		AGV vs. NSQ		AGV vs. RAND		SM vs. NSQ		SM vs. RAND		NSQ vs. RAND	
symmetric												
3	AGV	(11/13)	AGV	(10/11)	AGV	(7/8)	SM	(10/11)	SM	(11/12)	RAND	(10/10)
1	SM	(6/10)	AGV	(9/10)	AGV	(9/11)	SM	(10/10)	SM	(9/12)	RAND	(8/9)
−1	AGV	(9/13)	NSQ	(5/5)	AGV	(12/14)	NSQ	(14/14)	SM	(10/11)	NSQ	(11/11)
−3	AGV	(7/9)	NSQ	(19/19)	AGV	(11/12)	NSQ	(10/10)	SM	(8/10)	NSQ	(15/15)
right skewed (+7)												
7	AGV	(6/6)	AGV	(10/12)	AGV	(9/10)	SM	(14/14)	SM	(5/7)	RAND	(10/11)
1	AGV	(9/12)	AGV	(10/11)	AGV	(12/15)	SM	(11/11)	SM	(13/14)	RAND	(10/12)
−1	SM	(9/16)	NSQ	(9/10)	AGV	(5/7)	NSQ	(8/9)	SM	(11/13)	NSQ	(11/12)
−3	AGV	(5/8)	NSQ	(8/9)	AGV	(6/10)	NSQ	(8/8)	SM	(6/8)	NSQ	(7/7)
left skewed (-7)												
3	SM	(10/14)	AGV	(7/8)	AGV	(5/10)	SM	(16/16)	SM	(6/9)	RAND	(14/14)
1	AGV	(5/10)	AGV	(11/11)	AGV	(9/12)	SM	(17/17)	SM	(9/11)	RAND	(8/9)
−1	AGV	(7/13)	NSQ	(6/9)	AGV	(7/10)	NSQ	(5/5)	SM	(9/13)	NSQ	(6/8)
−7	AGV	(8/8)	NSQ	(17/17)	AGV	(12/13)	NSQ	(7/7)	SM	(11/12)	NSQ	(14/14)

Notes: The mechanism named in each cell was chosen by the majority of subjects with the specified valuation (number of subjects that chose the stated mechanism/total number of subjects with given valuation). Each subject makes each binary choice one time with a randomly drawn valuation. For each treatment the sum of choices of all four valuations within a binary comparison is the number of subjects: 45 in symmetric, 42 in right skewed and 45 in left-skewed treatment.

A.3 Translated instructions

This is the translation of the original instructions used for treatment one (symmetric distribution). The instructions for other treatments only differ with respect to the described distribution and therefore the used examples and tables. All emphasizes are in the original. The original instructions for all treatments are available from the authors upon request.

Instructions

Thank you for taking part in this experiment. The amount of money you can earn in this experiment depends on your choices and the choices of the other participants. It is therefore important that you understand the instructions. Please do not communicate with the other participants during the experiment. If you have any questions after reading the instructions, please raise your hand. We will then clarify your question.

All the information you provide will be treated anonymously.

You will begin the experiment with a starting budget of 9€. This amount can be increased or decreased depending on all participants' choices in on of the 18 rounds of this experiment. In each round each participant receives a payment. This payment can be zero, positive or negative. At the end of the 18 rounds, one round will be randomly determined for payment. The payment of the selected round will be added to or subtracted from your starting budget. The sum of your starting budget and the payment of the selected round yields your final payoff. In each round you should act as if the round was selected for payment. You will receive your final payoff in cash at the end of the experiment. The payments are chosen in such a way that you cannot make losses under any circumstances. Each participant can earn between 5.75€ and 12.25€. Your payment will be treated anonymously.

The entire experiment is organized in two phases. Phase I consists of rounds 1-12 and phase II of rounds 13-18. You will now receive information about phase I. We will explain any changes in phase II after round 12, but before the start of round 13 (the start of phase II).

Thank you for participating.

STRUCTURE OF THE EXPERIMENT

In each round of the experiment you will be part of a group with 3 members (you and two randomly selected other participants). Each group has the possibility to conduct a project, called project A. If you do not conduct the project each group member receives a payoff of 0€ for this round. If your group conducts project A, then each group member receives his or her private valuation for the project as payment for this round. The private valuation of project A can be different for each member of your group. If your group decides not to conduct project A, all group members receive a payoff of zero. The valuation for project A is newly determined each round and each participant receives a new private valuation in each round. Groups are newly formed in each of the 12 rounds.

The experiment is computer based. Therefore individual participants cannot identify the other group members. You will not know which other participants are in your group in which round, neither during nor after the experiment.

One round consists of two parts. In the first part each group choses a decision rule which is used to determine whether project A is implemented or not. In the second part your group uses the selected rule to determine whether project A is implemented or not. You will be informed about your private valuation for project A **after** part one of a round. We will now describe the two different parts of each round as well as the possible decision rules in detail.

PART ONE

In part one you have the choice between two different decision rules, which will be used in part two to determine whether project A is implemented or not. The two available rules change from round to round. **Each of the three group members suggests one of the two available rules for part two of this round. The computer randomly picks one of these suggestions as group rule. This decision rule determines how in part two the question whether project A is implemented or not is resolved.** The different rules are explained below. In part one you do not know whose rule suggestions will be the group decision rule. Your suggestion can be selected, but also the suggestion of another group member. Each group member has the same chance in each round for his or her suggestion to be selected. Non selected suggestions will not be made known to the other group members. Please note that the decision rule is important, because dependent on the decision rule the implementation of project A is easier or more difficult.

PART TWO

In part two the selected decision rule is used to determine whether project A is implemented or not. The group decision arises directly from the decisions of all group members in part two. The decision is announced and each participant is informed about his or her payment in this round.

VALUATIONS

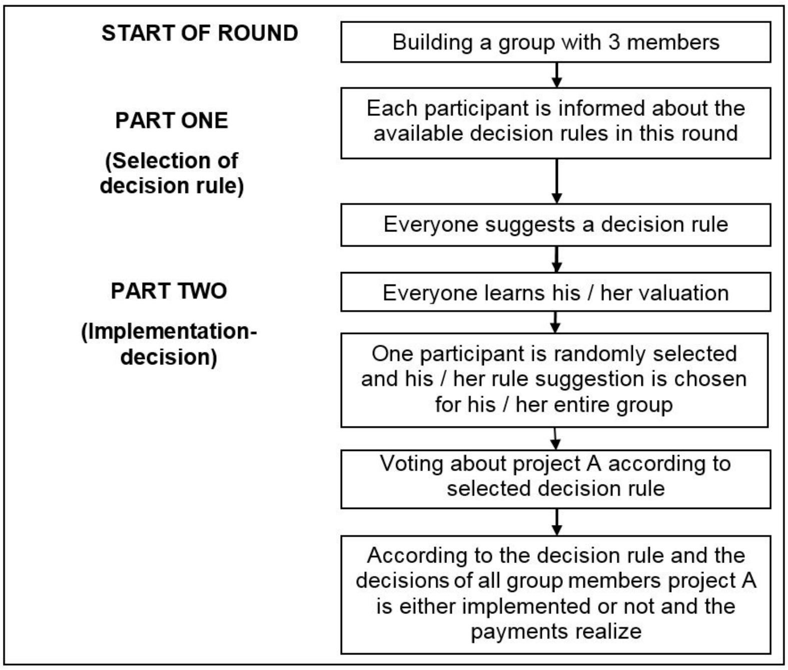
In case project A is implemented all group members receive a payment dependent on their project valuations. This means, if your valuation for project A is positive, you benefit from the implementation of project A, and when your valuation for project A is negative, then you have to pay if the project is implemented. **Your valuation for project A is randomly given to you in each round anew. You learn your valuation after part one.** Therefore you do not know your valuation when you decide between the different decision rules in part one, but you know your valuation in part two, when you decide about the implementation of project A according to the selected decision rule.

Please note that you will know your exact valuation for the project, but not the valuations of the other group members. The valuation of each group member can be -3€, -1€, +1€ or +3€. All values are equally likely. The values are independently distributed, such that your valuation in one round does not allow any conclusions for the valuation of other members in your group. Further your valuations are independent between rounds. Therefore your valuation in one round does not depend on previous or future valuations.

Example: Assume your valuation in round 1 is -1€ and +3€ in round 2. If your group decides to implement project A in both rounds, then your payment (not necessarily your final profit) in these rounds is your valuation. If round 1 would be randomly selected for payment, then your final profit in the experiment would be 8€ (=9€ - 1€). If round 2 would be selected your final profit would be 12€ (= 9€+3€).

If your group does not implement project A, each group member receives 0€ for this round, meaning in this round you neither gain nor lose anything, independently of your valuation for project A. Therefore if such a round is selected for payment, your final profit is your starting budget of 9€.

Here is the structure of the experiment in a short overview:



POSSIBLE DECISION RULES

In part one each group member has the choice between two decision rules. The rules are identical for all group members in each round. The following four decision rules (I.-IV.) are possible:

Rule I. Whether project A is implemented or not depends on the stated valuations of all group members. With this decision rule each group member states his or her valuation for the project in part two of the round. **If the sum of all stated valuations is larger than 0, then project A is implemented. If the sum is smaller, the project is not implemented.** Each participant has to state a possible valuation (-3€, -1€, +1€ or +3€). He can state his true valuation, but also any other possible valuation. The calculation of the sum only depends on the three **stated valuations** are added. The true valuations are not taken into account.

With this decision rule there are transfer payments between the group members additionally to the payments from an implementation of project A. The transfer payments depend on the stated valuation and the stated valuations of the other group members. You can see which transfers you receive / pay dependent on the stated valuations in table 1 below. Please note: A transfer payment is independent of your true valuation and the implementation of project A. You can also receive or pay a transfer if project A is **not** implemented. Transfer payments **only** exist in this decision rule.

Transfers are chosen in such a way that your expected payoff is maximized if you state your true valuation and also the other group members state their true valuation. The table states the transfers for all possible situations. The first column contains your statement and the respective columns to the right list the transfers dependent on the statements of the other group members.

	Stated valuations of the other group members:									
Your statement:	**3, 3**	**1, 3 or 3, 1**	**-1, 3 or 3, -1**	**-1, 1 or 1, -1**	**-1, -1**	**3, -3 or -3, 3**	**1, -3 or -3, 1**	**-1, -3 or -3, -1**	**1, 1**	**-3, -3**
3	0	-0.125	-0.125	-0.25	-0.25	0	-0.125	-0.125	-0.25	0
1	0.25	0.125	0.125	0	0	0.25	0.125	0.125	0	0.25
-1	0.25	0.125	0.125	0	0	0.25	0.125	0.125	0	0.25
-3	0	-0.125	-0.125	-0.25	-0.25	0	-0.125	-0.125	-0.25	0

Table 1

Example 1: Assume you state a valuation of -1€. If the other two group members state valuations of -1€ and 3€, then you receive a transfer of 0.125€.

Example 2: Assume you state a valuation of 1€. If the other two group members state valuations of -3€ and 3€, then you receive a transfer of 0.25€.

Example 3: Assume you state a valuation of -3€. If the other two group members state valuations of -1€ and 3€, then you receive a transfer of -0.125€. Therefore you have to pay 0.125€.

Example 4: Assume you state a valuation of 3€. If the other two group members state valuations of -3€ and -3€, then you receive a transfer of 0.

Please note that transfers payments are always made, independent of whether project A is implemented or not. You receive / pay a transfer **on top** of the payments from project A.

Rule II. At least two group members have to vote for the implementation of project A. In part two all group members vote either for or against the implementation of project A. At least 2 group members have to vote for the implementation, otherwise project A is not implemented **(simple majority**).

Rule III. Project A is never implemented. Group members do not make any further statements in part two. There is no voting and no valuations are stated.

Rule IV. The decision for or against implementation of project A depends on the result of a coin flip. There is no voting. If the coin flip results in HEADS, the project is implemented. If the result is TAILS, the project is **not** implemented. Both results, HEADS and TAILS, are equally likely. Therefore with rule IV. project A is implemented in 50% of all cases and not implemented in the other 50%.

Please note that in decision rules I and II each participant has to state a valuation / vote. It is not possible to abstain.

We now ask you to answer several understanding questions regarding the various decision rules and your possible payments. Please answer these questions on the computer screen. After all participants have answered the seven understanding questions all participants will take part in four practice rounds. In each round you will apply one of the four possible decision rules (I.-IV.). In these rounds there is no choice between two rules, but the rule is predetermined.

In these four rounds you are not in a group with two other participants. The computer simulates the decisions of your group members. The computer randomly choses between all available actions. E.g. with rule II the computer will vote "YES − implement project A" in 50% of all cases and "NO − do not implement project A" in the other 50%.

These four rounds do **not** count towards your final profit. They are just meant to familiarize you with the four possible decision rules. After all participants have completed these four rounds the actual experiment starts.