Flip a coin or vote? An experiment on the implementation and efficiency of social choice mechanisms *

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Abstract

Corporate boards, experts panels, parliaments and cabinet, and even nations all take important decisions as a group. Selecting an efficient decision rule to aggregate individual opinions is paramount to the decision quality of these groups. In our experiment we elicit the preferences of group members over several important decision rules and test the empirical performance of these decision rules. We find that: 1) the efficiency of the theoretically optimal rule is not as robust as simple majority voting and theoretical efficiency rankings can reverse in the lab; 2) participation constraints often hinder implementation of more efficient mechanisms; 3) these constraints are relaxed if the less efficient mechanism is risky; 4) participation preferences appear to be driven by realized rather than theoretic pay-offs of the decision rules. These findings highlight the difficulty of relying on theory alone to predict what mechanism is better and acceptable to the participants in practice.

Keywords: Experimental economics, Group choice, Choice rules, Mechanisms, Participation constraints, Individual rationality, Two-stage voting, Bayesian games, efficiency
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1 Introduction

Before a group takes a decision – whether it is a corporate board thinking about corporate investment, an expert panel considering different policies, or a nation considering who to appoint as president – the group has to select a mechanism, a decision rule that aggregates individual preferences into a group decision. With an inefficient mechanism, the group is likely to end up with a less than optimal outcomes - e.g. a bad investments, inefficient policies, unpopular presidential candidates, or simply deadlocked in discussions and forced to delay important decisions.[1] If a group finds that its existing decision rule does not work well, the group members could choose to use a different rule. Therefore, it is natural to expect inefficient rules to be replaced; however, in practice we regularly see inefficient mechanisms persist. We see, for example, veto rules or restricted voting rights that limit the amount of information combined in corporate boards and shareholder meetings (De Jong et al., 2007; Grüner and Tröger, 2019), mechanisms that do not work well with the reputational concerns in expert panels (Visser and Swank, 2007; Swank et al., 2008), or the much criticized US electoral college that survived more than a century of reform attempts (Rathbone, 2018). In this paper, we use an experiment to shed more light when and where we can expect inefficient mechanisms to be, or not be, replaced for efficient ones.

To improve group decision rules one has to take two necessary steps: design and implementation. First, we have to find an efficient mechanism for the particular context. Given the decisions at hand and the composition of the group, it might be better to use simple majority voting, or to aim for group consensus. Second, we have to ensure that all group members are willing to use the efficient mechanism. If the group wants to change from consensus to simple majority voting, a group member that does not like the project in question can simply refuse to participate in the simple majority voting. In a consensus mechanism, he can always refuse to participate in the project and force the status quo to persist. The corresponding design and participation problems have been studied extensively, both theoretically and experimentally, in the literature on exchange mechanisms like auctions and matching, and led to the development of the new field of market design.[2] In contrast, the experimental part of the literature on efficient mech-

[1] In the setting of this paper, mechanism and group decision rules are the same, we will use the terms interchangeably. For discussions and examples of how the decision rules used in these settings, see for instance: Malenko (2014); Gao and Huang (2018) about corporate boards, Swank et al. (2008); Hao and Suen (2009) about (expert) policy committees, and Colomer (2004); Benoit (2007); Goux and Hopkins (2008); Widgrén (2009); Warntjen (2010) for political examples.

[2] This literature is too large to survey here, numerous contributions can be found in collec-

anisms in social choice is limited. The overview of the experimental literature presented in Chen (2008) found only one paper directly analyzing the efficiency of the theoretically optimal mechanism, while tests of the participation decision only seem to have occurred in the class of simple voting rules (Engelmann and Grüner, 2013).

In this paper we address the gap in the literature on the implementation of efficient social choice mechanisms in two ways. We conduct an experiment with a two-stage procedure for collective decision making. In the first stage of the experiment, subjects individually choose their preferred decision rule from two available mechanisms (mechanism choice). The chosen mechanism reveals their willingness to participate in one mechanism over another, allowing us to assess the possibility of voluntary implementation of more efficient mechanisms. In the second stage of the experiment, each three-person group applies the mechanism chosen by a randomly selected group member to determine the provision of an indivisible public good (provision choice). The provision decisions of the experimental groups allow us to measure and compare the empirical efficiency of the mechanisms. Together, the revealed preferences and achieved efficiency levels allow us to show how private information, expected benefits and outside options – all difficult to observe outside the lab setting – influence participation preferences. Our experimental results thus show when groups can voluntarily switch to a better decision rule and whether the theoretically optimal decision rule delivers good decisions, both in a controlled lab environment.

Our results clearly show how the outside options and private information shape subjects' revealed preferences over mechanisms, and thus determine their participation decision. Subjects that know they dislike the public project, prefer a mechanism that does not allow provision over all other options. Subjects who like the public project, are willing to flip a coin to decide on the project as long as the that increases the probability of implementing the project. Furthermore, in our experiment both subjects that want to provice the public project and subjects that want to stop it, prefer to have influence over the outcome rather than flipping a coin. Therefore, with risky alternative mechanisms, voluntary participation in more efficient mechanisms can be possible even in ad interim stages. Our results directly relate to existing theory. We show that participation constraints depend on private information and the outside option – as suggested by a.o. the Myerson–Satterthwaite impossibility theorem (Myerson and Satterth-

tions like Plott (2008); Kagel and Roth (1997, 2016). The difference between stylized theory and chaotic practice found, has caused the literature on market design to used an ever more integrated approach combining theory and experiments (Roth et al., 2012; Roth, 2015).

waite, 1983). Even the more qualified theoretical results from Schmitz (2002), Segal and Whinston (2011), and Grüner and Koriyama (2012) – suggesting that the relative riskiness of the outside option allows the participation constraints to be relaxed – are clearly seen in the revealed preferences in our experiment. However, our results also show that the mechanisms are not as efficient in the lab as theory predicts, and the difference between theoretical predictions and measured efficiency depends on the setting and the mechanism. In some settings the predicted ranking is reversed, therefore theoretical expectations of (individual) preferences for mechanisms can be misleading.

In our experiment we study four mechanisms, the theoretical optimal Arrow-d'Aspremont-Gérard-Varet (AGV) mechanism[3], Simple Majority Voting, flipping a coin (random decisions) and a zero-implementation mechanism that mimics the theoretical effects of forcing the status quo to persist by non-participation in the mechanism choice. The optimal AGV mechanism is the theoretical benchmark to which the efficiency of all other mechanisms is compared. Despite its theoretical importance, the empirical performance of the AGV mechanism has not received much attention. To the best of our knowledge the only direct tests of its efficiency is in Attiyeh et al. (2000). They find that the AGV's empirical efficiency is no larger than the theoretical efficiency of sincere voting in a simple majority voting rule. Our experiment allows us to directly compare AGV's achieved efficiency to the achieved efficiency of the simple majority voting mechanism in several settings. The results show that the AGV mechanism is indeed more efficient in some settings, however, its efficiency gain over the simple majority mechanism is not as robust theory predicts and can even be negative. While we show that simple majority is also not as efficient as predicted in theory, the difference between its predicted efficiency and achieved efficiency in the lab is much smaller and much more stable across settings. The fact that the AGV's efficiency depends strongly on the setting as well highlights the importance of controlled tests for proposed mechanisms in social choice situations. Such tests are already the standard in the field of market design for very similar reasons (Roth et al., 2012).

The biggest difference between the theorectic and empirical efficiency of the AGV and the simple majority voting mechanisms is caused by misreporting and non-sincere voting. Like Attiyeh et al. (2000), we find strong indications

[3]The original mechanisms was derived in Arrow (1979) and d'Aspremont and Gérard-Varet (1979). In our setting, the mechanism is part of the class of Vickrey-Clarke-Groves mechanisms that have been derived from foundational work by Vickrey (1961); Clarke (1971); Groves (1973). It is also known as a version of the Expected externality mechanism, or pivot mechanism Tideman and Tullock (1976).

that individuals try to strategically change their revealed preference to obtain a more desirable outcome than possible in the truthful Nash-equilibrium. The difference between theoretical efficiency and achieved efficiency of the mechanisms, means that our subjects' preferences over mechanisms could be difficult to predict through theory alone. Remarkably, subjects appear able to predict relative efficiency levels in the lab and select the mechanism that maximizes their expected pay-off in the lab, even when the efficiency deviates from theoretic predictions. In the setting where the majority voting mechanism is close to efficient, it is selected much more often than in the setting where the AGV clearly outperforms simple majority voting in the lab.

Another difficulty of predicting the participation decisions and efficiency through theory alone is the possibility of that individuals hold non-standard or social concerns. Group members that care about the utility of their fellow group members should attach a higher value to efficient mechanisms (Engelmann and Grüner, 2013), and thus choose differently than rationally self-interested group members. Similarly, socially concerned individuals might make different choices in a given mechanism, such that the efficiency predictions derived under narrow self-interest have to be adjusted (Messer et al., 2010; Bierbrauer et al., 2017). However, in our setting, where we cleanly identify participation decisions *and* see the play in the selected mechanisms, narrow self-interest is the most important predictor. In fact, subjects prefer complete randomness over arguably fairer and more efficient mechanisms, as long as randomness gives them a better chance to obtain their preferred outcomes.

The implementation of a group decision rule, through its consequences on outcomes and payoffs, is a contentious issue. If a group has to rely on voluntarily participation of all members, very few decisions would actually be taken. Even in the three-person groups of our experiment, we see non-participation in a large majority of groups. A group that has to take a series of decisions would find itself incapacitated quickly. In public projects and reforms, large groups of participants have 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 type of inertia caused by participation constraints in our experiments would make large public projects virtually impossible to negotiate (Mailath and Postlewaite, 1990). As a consequence, our results provide a rationale for the existence of coercive power in group decisions. By forcing group members to participate in specific projects, the group surplus over a number of projects can be increased. While any given project might not satisfy the participation constraints of all individuals, as long as the sum of all projects is better than full non-participation, individuals are better off accepting the group's decisions and submitting to coercion in specific projects.

The rest of the paper is organized as follows: Section 2 summarizes the previous research on group mechanism choices and participation constraints. Section 3 outlines the experimental design and the three treatments. Section 4 states the theoretical predictions, Section 5 discusses how these predictions are borne out by the data and discusses further findings. Finally, Section 6 concludes.

2 Related literature

Our experiment is closely related to the social choice literature and the choice of voting rules or constitutions. This, mostly theoretical, literature is riddled with impossibility theorems. These impossibility results show it is not possible to design a social choice rule, or mechanism, that combines a set of desirable properties in every imaginable circumstance. Most famously, Arrow (1950) shows 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.[4]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) and Güth and Hellwig (1987) for the private supply of a public good. In all these settings, when the mechanism choice is made through a veto rule (i.e. voluntary participation by all players), efficient production cannot be reached unless a subsidy is provided. These impossibility results illustrate how participation constraints can stifle any chance of (efficient) mechanism change, and all have the same effect in our setting. Since the Myerson-Satterthwaite theorem is the most famous of these impossibility results, we will refer to this type of result as the Myerson-Satterthwaite theorem.

Several papers in the social choice literature illustrate how impossibility results

[4]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 (2016). The interpretation in this paper is mostly due to Cramton et al. (1987).

depend on the mechanism that occurs if the efficient mechanism is rejected. These papers turn impossibility results into subtle possibility results that depend on the risk in the outside option, we study part of their theoretic predictions in this experiment. Cramton et al. (1987) show that a status quo that specifies a more or less equal distribution of the good (ownership rights in their setting) makes it 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 efficient 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 mechanism to be voluntarily adopted and does not violate ad interim individual rationality. In case the valuation of the public good is identically and independently distributed, such a status quo can always be found. Under i.i.d. private valuations, this result implies that a status quo mechanism exists that will allow a voluntary implementation of the efficient mechanism ad interim, both for the bargaining game of Myerson and Satterthwaite (1983) and for the provision of a public good. 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. Their proposition 1 states that individuals are willing to accept an efficient mechanism if it has the same equilibrium distribution over allocations as the alternative mechanism, a condition we recreate in our experiment. Grüner and Koriyama (2012) illustrate that in some cases it is even possible for groups to shift from a (simple) majority voting system to the AGV mechanism without violating interim participation constraints. In a binary choice situation the efficiency gains of the AGV over majority voting systems are very limited, such that this is quite a remarkable result. However, for some distributions of valuations and probabilities, the efficiency gains are large enough to compensate individuals for the potential loss in information rents. As the AGV and SM mechanism are important for theory and practice, respectively, we also test this prediction in our experiment.

Two closely related experimental papers study the effect of social preferences on mechanism choice. Bierbrauer et al. (2017) identify the theoretically optimal mechanism assuming players have other-regarding preferences. 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 social planner should prefer a different mechanism than with narrowly self-interested agents. If social preferences play a role in our mechanisms, the theoretical predictions derived in models with narrowly self-interested agents might not hold and the AGV would not be optimal. The article most closely related to ours is Engelmann and Grüner (2013), who also implement a two-stage group decision experiment for the provision of a public good. In their experiments, groups of five subjects select their preferred thresholds, the number of votes required for implementation of the public good, using a similar mechanism choice stage as our experiment. A narrowly self-interested, rational subject should always prefer the voting rule that requires only one (all five) vote(s) for implementation, if she has a positive (negative) valuation of the project. The same subject should vote in favor of (against) implementation in the second stage to get the preferred outcome. However, subjects often choose mechanisms that require two, three or four positive votes for implementation instead. Choosing for a threshold of two, three, or four votes could be explained by efficiency or pro-social concerns in the mechanism choice stage. If social concerns play a role in mechanism choices, this could be leveraged to get more efficient mechanisms adopted in the real world. We put this idea to a more direct test, with a clearer identification of the outside option and different types of mechanisms in our experiment. However, our results do not show indications of pro-social or efficiency concerns in mechanism choices.

The efficiency of the AGV mechanism is very important in theoretic work, but to the best of our knowledge the only other direct test of AGV's efficiency was in Attiyeh et al. (2000). In their experiment groups of either 5 or 10 subjects are asked to play a direct revelation game for the provision of a public good. Like in our experiment, the group outcome was binding on all participants and each subject had a private valuation for the project that was randomly redrawn from a range containing both positive and negative values. Unlike our setting, they allowed any cent value in the range $[-10, 10]$. Interestingly, they found that only about 10% of the 'revealed preferences' exactly matched the private values, and this was mostly driven by 1 very honest subject. Almost all messages did report the correct sign of their preferences, indicating that many individuals tried to 'game the system' despite its truthful Nash-equilibrium. Increasing the number of participants in a group did not have much effect on misreporting. As subjects in the experiment of Attiyeh et al. (2000) did not play any other mechanism, they cannot compare the empirical efficiency of different mechanisms. In this paper we compare the efficiency of AGV to that of Simple Majority Voting to show how and when the AGV is empirically better.

3 Experimental design

We first describe the game subjects played and the mechanisms used. We then describe the treatments and the procedures of the experiment. Treatments differ only in 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, 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 consists of two stages. 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 choose between two of them. The mechanisms we consider are:

Mechanism I AGV mechanism (AGV)
: 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. If the sum is smaller than zero 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. The project is implemented with 50 % probability 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 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 or 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 random dictator elicitation for the mechanism choice clearly differs from the theoretical mechanism-design setting in two important ways. First, we force subjects to choose between two given mechanisms, rather than from the universe of potential mechanisms. Providing subjects with a binary choice set has the methodological advantage that it identifies subjects' outside option and allows us to manipulate the outside option by changing the second mechanism. The drawback, a reduced choice set for participants, is unavoidable in any realistic empirical setting. Even by only considering direct revelation games, such that any mechanisms can be chosen that maps from the reports to the implementation decision and payments, subjects would have to choose from an infinite and multi-dimensional set of options. Such choices are too demanding both on the experimental set-up and on the subjects. Furthermore, with more than 2 alternatives we would immediately lose the ability to cleanly identify the outside option considered by our participants. Secondly, we follow the standard experimental methodology of randomizing the order of presentation in the mechanism choices, rather than labeling one mechanism as the status quo or default. The randomization of the order of presentation prevents response biases and thus allows a cleaner identification of preferences.

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).

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 to begin with the design that delivers the cleanest decisions in the ex-ante rounds. 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 respects similar to the two-stage 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. The mechanisms allow us to make the same comparisons studied in the theoretical papers cited above. We describe the theoretical properties of the mechanisms used and the reasons for selecting these mechanism in the next subsection. Third, Engelmann and Grüner (2013) did not look at the effects of private information on the behavior of subjects, while varying the amount of private information possessed by participants is an important aspect of our set-up.

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 or pivot 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). The expected surplus generated by the project is calculated based on the reports 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.[5] By including the externality in their pay-offs, the mechanism forces individuals to take the expected surplus generated for the other players into account. As a result, all individuals are residual claimants of a value equal to the expected societal surplus the generate (their own surplus, plus the externality on others). Consequently, they should send the message resulting in the highest expected social surplus. Since the AGV leads to first-best efficient implementation 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 NSQ mechanism resembles the opportunity for individuals not to take part in a decision process and thereby preventing a group decision. It therefore mimics non-participation in the mechanisms as found (a.o.) in Myerson and Satterthwaite (1983). The RAND mechanism introduces an uncertain status quo and is chosen to reproduce the comparisons with intermediate allocation as studied in Schmitz (2002) and Segal and Whinston (2011). The SM mechanism is chosen for two reasons. First, it is a common mechanism 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 can use it to reproduce the theoretical choice setting of that paper.

3.3 Treatments

In all treatments a uniform distribution over a type space with four possible valuations (in €) 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.

[5] The translated instructions for the symmetric treatment in A.3 include a table of all possible transfers.

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 as well as the theoretical predictions we test.

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. In sessions with 18 or more participants there were two independent matching groups and subjects were only matched within these independent matching groups. 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 6 to 24 subjects, resulting in 150 participants in 15 matching groups (45 subjects and 4 matching groups in the symmetric, 42 subjects and 4 matching groups in the right skewed, 45 and 5 matching groups in the left-skewed treatment and 18 subjects in 2 matching groups in a robustness check session we describe in Section 5.4.1). 85 (57%) Subjects were male and the average age of participants was 23 years.[6]

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. Upon arrival in the lab the game played in the first 12 rounds was explained to the subjects. Subjects were aware of the existence of rounds 13-18 at the begin-

[6]The translated instructions for the symmetric treatment are in A.3. Screen shots from the original zTree program are in A.4

ning 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. 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 screens of the subjects was randomized between the three blocks. Initially we also planned to run sessions with ad-interim rounds before the ex-ante rounds. However, since we found no indications of order effects in the mechanism choices, see Section 5.1, but did have extra questions regarding the reporting strategy in the AGV, we ran the extra session reported on in Section 5.4.1 instead. 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. All calculations required to derive our predictions can be found in the appendix.

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 expected payoff of each mechanism depends on the private valuations and therefore on the treatment. Table 2 below displays the preference ordering over mechanisms in the ex-ante rounds for each treatment.[7] Because the AGV is the only theoretically 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. Under even a small amount of risk aversion, subjects would strictly prefer NSQ.

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.[8]

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

[8] 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 ex-

Table 2: Predicted mechanism choices (ex ante)

Treatment	Ordering of mechanisms						
symmetric	AGV	≻	SM	≻	NSQ	∼	RAND
right skewed (+7)	AGV	≻	SM	≻	RAND	≻	NSQ
left skewed (-7)	AGV	≻	SM	≻	NSQ	≻	RAND

Notes: ≻ and ∼ indicate the preference ordering over the four mechanisms for a risk-neutral subject. The ordering of mechanisms corresponds to their expected payoffs in the respective treatments.

By definition, all subjects are equal at the ex ante stage, and thus the payoff-maximizing mechanism for each individual subject also maximizes the expected group surplus. Since the AGV and SM mechanisms are more efficient than NSQ and RAND, without private information payoff maximization thus induces subjects the AGV and SM over NSQ and RAND. Similarly, ex ante the AGV should be preferred over SM if the truthful equilibria are played. If there are deviations from equilibrium, the preferred mechanism can depend on the realized efficiency of the two mechanisms.

Prediction 1. *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 mechanism 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 we can immediately conclude that the NSQ, with a zero probability of implementation, dominates all other options for individuals with a negative project valuation.[9] This is essentially what application of the Myerson-Satterthwaite impossibility theorem entails in our setting: interim individual rationality makes all incentive compatible mechanisms less appealing than simply not participating for about half of our subjects.

Prediction 2. *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.

pected 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 pay-off of the AGV and SM are still positive, 0.453125€ (AGV) and 0.25€(SM), while the expected payoff for the NSQ mechanism remains at 0€and is negative, -1€, for RAND.

[9]The appendix shows that the expected transfers are never large enough to influence the

Table 3: Predicted mechanism choices (ad interim)

Treatment	Valuation	Ordering of mechanisms						
symmetric	3	AGV	$\succ$	SM	$\succ$	RAND	$\succ$	NSQ
	1	AGV	$\sim$	SM	$\succ$	RAND	$\succ$	NSQ
	−1	NSQ	$\succ$	SM	$\sim$	AGV	$\succ$	RAND
	−3	NSQ	$\succ$	AGV	$\succ$	SM	$\succ$	RAND
right skewed	7	AGV	$\succ$	SM	$\succ$	RAND	$\succ$	NSQ
	1	AGV	$\succ$	SM	$\succ$	RAND	$\succ$	NSQ
	−1	NSQ	$\succ$	SM	$\succ$	AGV	$\succ$	RAND
	−3	NSQ	$\succ$	SM	$\succ$	AGV	$\succ$	RAND
left skewed	3	SM	$\succ$	AGV	$\succ$	RAND	$\succ$	NSQ
	1	SM	$\succ$	AGV	$\succ$	RAND	$\succ$	NSQ
	−1	NSQ	$\succ$	AGV	$\succ$	SM	$\succ$	RAND
	−7	NSQ	$\succ$	AGV	$\succ$	SM	$\succ$	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 and valuation.

Schmitz (2002) and Segal and Whinston (2011) show that by replacing the safe outside option with riskier ones, the impossibility in prediction 2 can be overcome. In our experiment, their results translate to the prediction that the AGV should be preferred over RAND *even* with private information. Similarly, the SM mechanism is much more efficient than the RAND mechanism but they have the same distribution of outcomes in expectation, so all subjects should choose the SM over the RAND mechanism.

Prediction 3. *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. The remaining results for which the conditions are met translate to the following qualified predictions:

Prediction 4. *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:

preference over mechanisms in our setting, hence we ignore these here.

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

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 a similar "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, in particular in the ex-ante rounds. In the ad-interim rounds, we expect private benefits to dominate fairness concerns so that the later should not affect mechanism choices.

Prediction 5. *The AGV mechanism is chosen more often*

(i) in the right-skewed treatment than in the left-skewed treatment
(ii) this preference is more pronounced in the ex-ante rounds then in the ad-interim rounds.

5 Results

We present the results following the order of the experiment, starting from the ex-ante mechanism choices. Next, we present our findings on the Myerson-Satterthwaite impossibility theorem and discuss the ad-interim mechanism choices. We then discuss the achieved efficiency of the AGV and SM mechanisms, before concluding with an analysis of subjects' behavior in stage two of the AGV (value reports) and the SM mechanism (voting) to show what drove the realized efficiency.

5.1 Ex-ante choices

In this section we analyze subjects' mechanism choices in the ex-ante rounds (rounds 1-6). We focus on the results of the first block to ensure independence of our observations, but including the later rounds does not have a large impact on our results.[10] In the interest of space we concentrate on the results of the symmetric treatment, since most results are not qualitatively different among treatments. We only discuss the mechanism choice in the skewed treatments where this is particularly interesting.

[10]Table 9 in the appendices displays all choices.

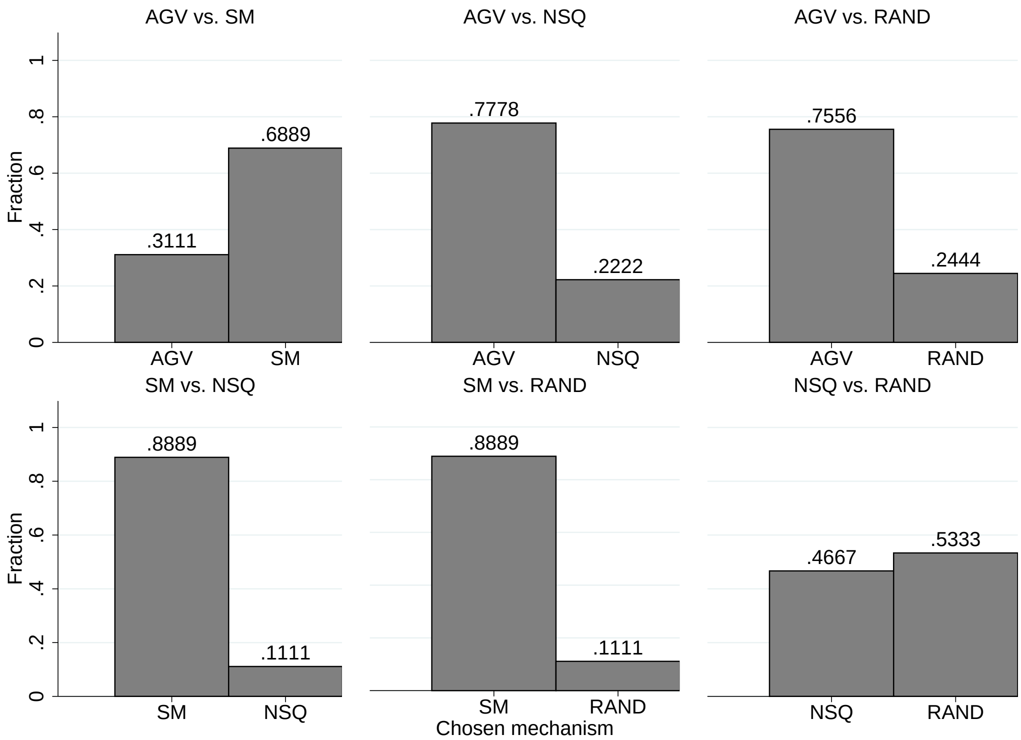

Figure 1: Ex-ante binary choices (symmetric treatment)

The choices made in the six binary ex-ante comparisons in the symmetric treatment are shown in Figure 1. In five cases there is a clear majority for one mechanism: AGV and SM are clearly preferred to NSQ and RAND and SM is generally chosen over AGV.[11] There is no clear preference in the choice between NSQ and RAND, subjects are almost evenly split between these mechanisms and a binomial test does not reject a 50:50 split (p-value 0.77). Given that both mechanisms have an identical expected payoff this indifference seems to indicate risk neutrality of our subjects. Only in the choice between AGV and SM the majority of subjects does not prefer the mechanism that theory predicts has the larger expected payoff. We will come back to this issue in Section 5.4.[12]

Table 4 below shows the mechanism selected by a majority of subjects in the first ex-ante block. The prediction that subjects select the most efficient mechanism corresponds to completely unanimous choices in every comparison. While unanimity by all is clearly not the case, in most comparisons one mechanism is preferred by a large majority. Although the predictions concentrate on indi-

[11]Binomial tests confirm a significant differences from a 50:50 split for these five comparisons (p-values < 0.05).

[12]Which of the two mechanisms is listed first seems to be without effect. We vary the order of comparisons between sessions, but there are no signs of order effects in any direction. Using two-sided Fisher's Exact tests yields no significant difference of the individual mechanism choices dependent on the mechanism listed first (all p-values above 0.3 for the symmetric treatment).

vidual choices, Table 4 presents the modal choice in each comparison. 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 transitivity, this aggregation is consistent with the preferences of our 'average' or median subject.

The modal stated preference goes in the predicted direction for all but three comparisons. In the symmetric and the right-skewed treatments the AGV is not preferred to the SM mechanism and in the left-skewed treatment the NSQ mechanism is not preferred over the RAND mechanism.

Table 4: Mechanisms chosen by a majority of subjects in the ex-ante rounds

Treatment	AGV / SM	AGV / NSQ	AGV / RAND	SM / NSQ	SM / RAND	NSQ / RAND
symmetric	SM**	AGV	AGV	SM	SM	NSQ $\backsim$ RAND
right skewed (+7)	SM $\backsim$ AGV*	AGV	AGV	SM	SM	RAND
left skewed (-7)	AGV	AGV	AGV	SM	SM	NSQ $\backsim$ RAND*

Notes: The mechanism in each cell was chosen by the majority of subjects in the respective treatment. All results are for the first comparisons (rounds 1-6). The number of observations for the three treatments are: 45 (symmetric), 42 (right skewed) and 45 (left skewed). Binomial tests reject a 50:50 split at the 5%-level for all but three comparisons: NSQ vs. RAND in the symmetric and left-skewed 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 (see Section 5.4 for details).

In the symmetric (69%) and right-skewed treatment (55%) a majority of subjects chose the SM over the AGV mechanism. The modal preferences flips around for the left-skewed treatment where 69% of subjects prefers the AGV.[13]

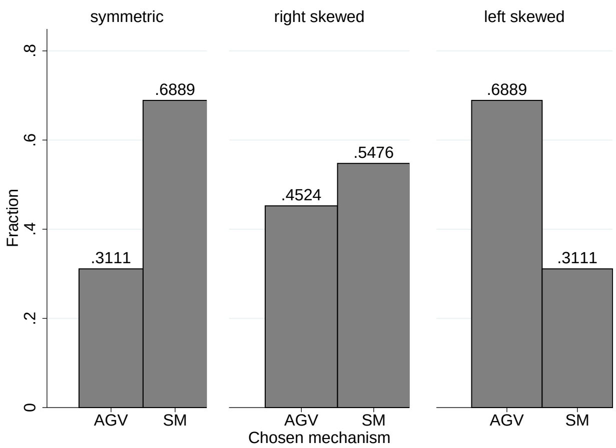

Figure 2: Ex-ante choices between AGV and SM mechanism (by treatment)

[13]Comparing the average mechanism choice on the matching group level between treatments using Mann-Whitney-U (MWU) tests yields significant differences between the symmetric and the left-skewed treatment (p-value 0.01) and between the right-skewed and the left-skewed treatment (p-value 0.05). The difference between the symmetric and the right-skewed treatment is not significant (p-value 0.14).

Comparing subjects' choices with the realized surplus in Section 5.4, 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 and in the left-skewed treatment for the comparison between NSQ and RAND. It seems that the modal mechanism choice of subjects is almost perfectly in line with the ordering predicted by realized efficiency. Simultaneously, the pattern of individual choices between AGV and SM appears to be consistent with the relative advantage of the AGV over SM.

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 1. Comparing the choices between AGV and SM between the right and left-skewed treatments, also shows we can already reject prediction 5. 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, rather than any form of other-regarding preferences.

5.2 Impossibility results

The Myerson-Satterthwaite 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.[14] 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 the subjects with a positive valuation and then for those with a negative valuation. Since subjects do not know their valuation when making the mechanism choice ex ante (top row), the choices of the subjects with positive and negative valuations are statistically indistinguishable.[15]

The expected choice reversal can be seen by comparing the graphs in each column. The change in choices is obvious in all three comparisons: AGV and SM are preferred over the NSQ in the ex-ante round (top, columns one to four) and the RAND and NSQ mechanism are about equally likely to be chosen (top, columns five and six), these choices reverse for virtually all subjects with a negative valuation in the ad-interim round. In our experiment subjects with a negative valuation prefer the NSQ over the other mechanism (bottom, columns two, four

[14] Results for the other treatments are very similar and are in the appendix in Figures 6 and 7.

[15] Comparing the average of the chosen mechanism between subjects with positive and negative private valuations yields no significant difference for all 9 ex-ante comparisons (three per treatment, MWU tests using matching group averages by valuation, p-values > 0.18).

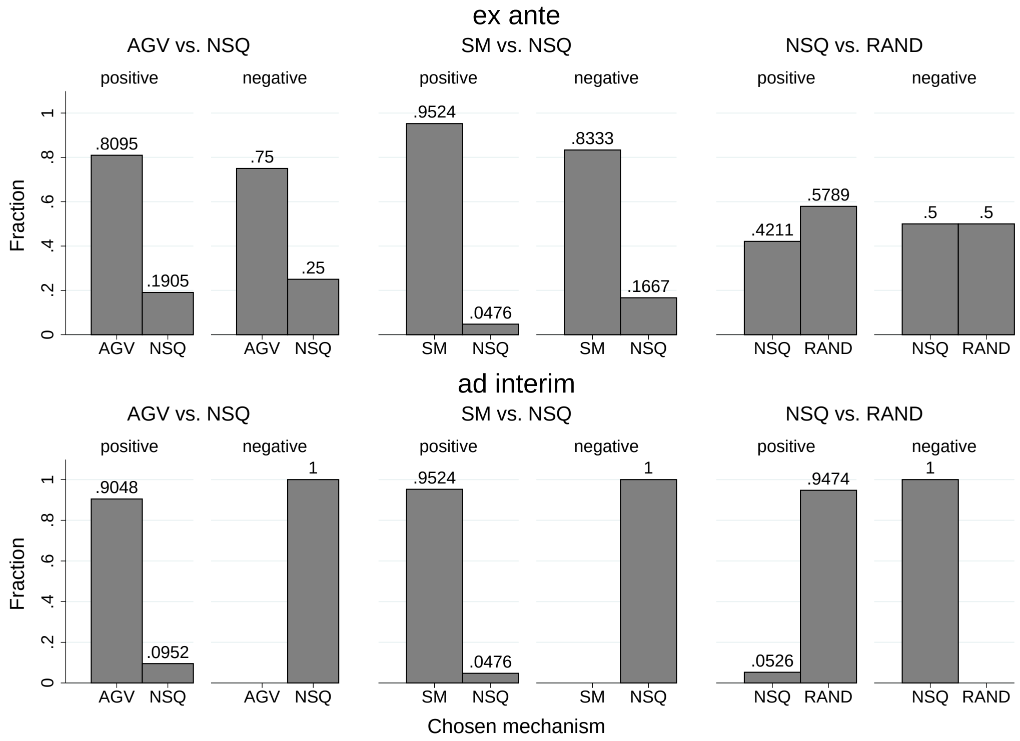

Figure 3: Mechanism choice by positive/negative private valuation (symmetric treatment)

and six).[16] These results confirm prediction 2: 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, and ex ante the choices of subjects seem to indicate indifference. With private information, however, subjects' revealed preferences are almost perfectly correlated with valuations: NSQ is preferred by subjects with a negative valuation, and RAND by subjects with a positive valuation. Even complete randomness is acceptable, as long as it increases private income (at least in the lab). Unlike the behavior observed by Engelmann and Grüner (2013), in our setting mechanism choices appear almost perfectly rational and narrowly self-interested. Social or efficiency concerns seem not to affect the chosen mechanism ad interim.

[16]MWU tests show significant differences between types' mechanism choices in the ad-interim rounds. The tests use the average mechanism choice on the matching group level: p-values < 0.05 for all but one comparison. The AGV vs. NSQ comparison in the left-skewed treatment shows weakly significant difference (p-value 0.06).

5.3 Ad-interim choices

We now turn to the results for the other ad-interim comparisons. Prediction 3 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.[17] Figure 4 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 than a save status quo.[18]

Unlike with the preferences for AGV/SM over NSQ, the private valuation of subjects has no influence on the preference for AGV/SM over RAND. Comparing the ad-interim mechanism choices within treatment yields insignificant differences for all six comparisons (two comparisons per treatment using MWU tests on the matching group level by private valuations, p-values > 0.18). In short, the average subject appears to prefer AGV/SM over RAND ad interim as well as ex ante.

Prediction 3 is actually 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 describes the data reasonably well, for almost all valuations a majority of subjects prefers the AGV mechanism. There is one exception, in the left-skewed treatment the AGV and RAND 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 is chosen by at least 60% of the subjects and in most cases it is chosen by a larger margin.[19]

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 4 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

[17] We show the results of all ad-interim choices separately for treatments and private valuations in Table 10 in the appendix.

[18] Binomial tests reject an equal distribution in all treatments (p-values < 0.01).

[19] 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 because the low number of cases (8-15 per valuation-treatment combination) results in relatively high p-values.

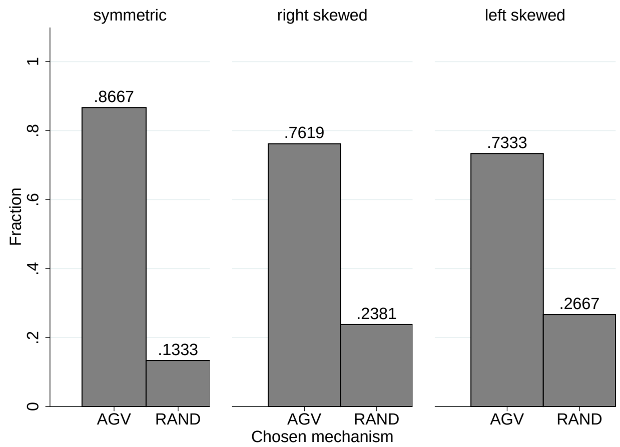

Figure 4: Ad-interim choices between AGV and RAND mechanism (by treatment)

decreases with valuation in the left-skewed treatment. The only exception to the trend is the -3 type in the right-skewed treatment.

The AGV mechanism is preferred by all subjects with the most extreme private valuations (+/-7). Subjects with a more moderate valuation of +/-1 are almost evenly split between the AGV and SM 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 4 is not fully confirmed.

5.4 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, if subjects misreport their valuation or vote insincerely, the realized efficiency of both mechanisms becomes an empirical matter.

We do not use the actual surplus generated in the lab as our measure of efficiency. This measure of efficiency would be 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

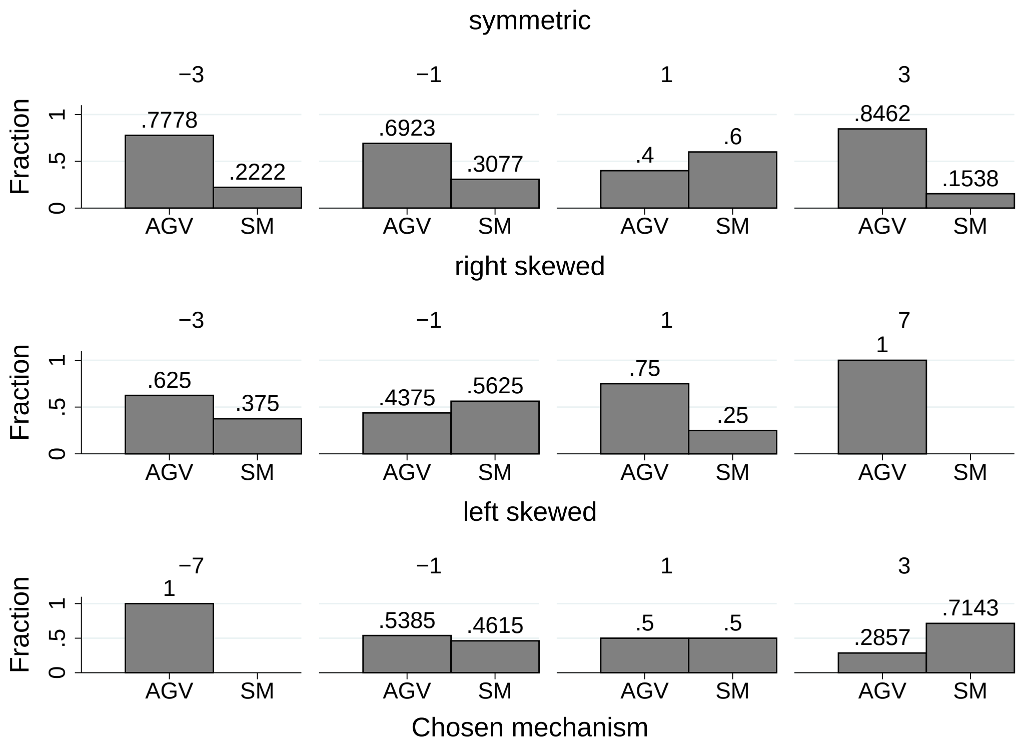

Figure 5: Ad-interim choices between AGV and SM mechanism (by treatment and valuation)

in that treatment. We calculate project implementation probabilities for all permutations of the type vector given these strategies. The realized surplus (in €) is the expected value of the group surplus in the mechanisms given these observed behavioral 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 strategies. Equivalently, the realized surplus can be interpreted as the expected value of the next, unobserved round given these behavioral strategies.

Table 5 below shows the Bayes-Nash equilibrium surplus and the realized group surplus for the AGV and SM mechanisms in the ex-ante rounds in all treatments.[20] 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.

While, the results in Table 5 clearly show that the AGV generates a higher ex-

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

Table 5: 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%)

pected surplus than the SM mechanism in theory, the table also illustrates that neither mechanism reaches its full theoretical efficiency level. The AGV is still the most efficient mechanism ex ante in the two skewed treatments. In the symmetric treatment, however, the efficiency ranking is reversed. In a symmetric setting the SM mechanism is theoretically very close to optimal, which reduces the advantage of the AGV. Simultaneously, the realized efficiency of the AGV is quite low in this treatment. The theoretically optimal AGV mechanism only realizes an expected group surplus of 1.18, while SM reaches a surplus of 1.34. This reversal of the efficiency ordering of AGV and SM makes it very difficult to predict preferences over mechanisms in the lab if subjects are sensitive to achieved efficiency, as subsection 5.1 shows.

The deviations from efficiency predictions stem from subjects' second stage reporting (AGV) and voting (SM) strategies, which are analyzed next.

5.4.1 Voting and reporting behavior

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. For the SM mechanism no such instruction was necessary, as the game is dominance solvable. In SM, voting in line with ones preferences is (part of) the best-response strategy regardless of the behavior of other players.

Table 6 shows four tables, one for each of the 3 treatments and one for a robustness-check session. Each table shows 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 would 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

Table 6: AGV reports (ex ante)

(a) symmetric treatment

True valuations	Reported 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 valuations	Reported valuations 7	1	−1	−3	Total
7	43	1	0	0	44
1	13	29	1	0	43
−1	3	8	11	24	46
−3	6	5	5	37	53
Total	65	43	17	61	186

(c) left-skewed treatment

True valuations	Reported 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

(d) robustness session

True valuations	Reported valuations 3	1	−1	−7	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

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 does not want the project to be implemented. By reporting a positive valuation she increases the probability of implementation, which can never be optimal. The same argument, with reversed signs, holds for positive valuations. Therefore, while over- or under-reporting can be rationalized by small mistakes(at least to some extent), misreporting the sign of the valuation cannot.

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 subjects with a positive valuation misreports the sign. In striking contrast, 22 of the 51 misreports from subjects with a negative valuation include an incorrect sign (43%). This pattern is not limited to the right-skewed treatment as we show in Tables 6a and 6c. This pattern is also not caused by a few individuals, 30% of reports differ from true valuations and 25% of subjects incorrectly report the sign of their valuation at least once. These averages are also quite stable over rounds. Such that it seems unlikely that the underlying behavior is driven by confusion in the early rounds. This pattern of reports is not found in Attiyeh et al. (2000) where there appeared to be more symmetry between the positive and negative valuations in misreporting.[21] However, the fraction of

[21]The distribution of the reports is not reported in the original paper, but they are available on the websites of the original authors. In Attiyeh et al. (2000) there are 25 truthful reports for subjects with positive and 29 with negative valuations, while 48% of subject-periods have a positive valuation.

subject reporting truthfully is higher in our experiment, which could be due to the information structure and slightly simpler setting, see Kawagoe and Mori (2001).

We ran an additional, robustness session that eliminates most reasons for misreporting as a robustness check. In this session, private valuations were drawn from the set {-3€, -2€, -1€, 7€}. These valuations result in identical transfers and implementation probabilities for all negative reports, such that 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 experimental screens in all treatments displayed the + and - signs for all valuations). The AGV reports in the ex-ante rounds of this session are shown in Table 6d.

Eliminating most misunderstanding possibilities in the robustness session results in fewer reports with an incorrect sign. While 35% of all reports are false reports, only 4 (15%) include an incorrect sign and most notably only 2 are from subjects with a negative valuation. In the robustness session, subjects with a negative valuation are substantially less likely to misreport the sign compared to the other treatments. We conclude that some, but not all, of the misreported signs in our main treatments are likely to have been mistakes.

5.4.2 Surplus consequences of false reporting

In order to approximate the loss in expected group surplus caused by the two different types of false reports, we adjust the calculations of Table 5 by respectively excluding over- and under-reporting or misreporting the sign from the observed strategies. Table 7 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 efficiency loss compared to theoretical expectations is mostly caused by 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.[22]

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%

[22]The sum of surplus lost by the individual types of false reports does not add 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.

Table 7: Effects of different types of false reports (ex ante)

	All reports correct	All reports		Effect of over- / under-reports		Effect of sign misreports	
Treatment	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 *Effect of over- / under-reports* [*Effect of sign misreports*] calculate the group surplus after removing all reports with a false sign [that over- or under-report] from the behavioral strategy of the subjects. The *lost* columns show the absolute (relative) loss of group surplus compared to the theoretical group surplus under truthful reporting.

to 100% of the rounds. There is no pattern of non-sincere 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.

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 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, and our data does not reveal the reason for the asymmetric behavior.

6 Conclusion

Designing and implementing more efficient mechanisms are two necessary steps to improve the decision quality of any group involved, whether it is a corporate board, public or private committee, or even a nation. This paper presents the results of a first experimental study in a social choice setting that combines these aspects. Our results demonstrate that subjects' mechanism choices respond to private pay-off differences between the mechanisms. In almost all ex ante 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. After subjects become aware of their private preferences, they make mechanism choices that increase the probability of getting their desired outcomes. As predicted by theory, selecting group decision rules ex ante is most likely to lead to efficient mechanisms. However, what the most efficient mechanism is, appears to be an empirical question, as theoretical results on efficiency rankings can be misleading in practice.

It is often not possible to select a decision rule in the ex ante stage. Simultaneously, it is difficult to change to an efficient mechanism through a completely voluntary procedure ad interim. The combination of these two difficulties is a contributing force for the persistence of inefficient mechanisms in real life. In many cases, the individuals that have to agree to a change of mechanism, are the same ones that cannot agree on the desired outcomes through the existing mechanism. The conflict over outcomes thus spills over to the mechanism selection stage, as we see in our experiment. Our results thus highlight the practical importance of participation constraints in the design of social choice institutions.

In our experiment, behavior in the ad-interim rounds is largely consistent with theoretical predictions. As the Myerson-Satterthwaite theorem and related impossibility results predict, the same subjects who prefer the efficient AGV mechanism ex ante, suddenly opt for the complete inertia of the zero-implementation to force the status quo after learning their private valuation is negative. 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 appears consistent with their theoretical predictions, clear majorities for either AGV or SM often do not exists. More importantly, theoretical efficiency gains and empirical efficiency gains are not the same, such that a rational (lab-)participant might have different preferences over mechanisms than predicted by theory.

That choices in our experiment confirm the effects of background risk on participation, as predicted by Schmitz (2002); Segal and Whinston (2011); Grüner and Koriyama (2012), serves as a reminder to consider the outside options used in designing mechanisms, contracts and institutions. Simply equating the outside option to zero, or constant utility, can have consequences for participation, which in turn can effect behavior in the game. In these cases, equating the outside option to zero is more than just a normalization, it is a modeling choice that impacts the results found.

The difficulties of changing existing group decision rules, shown here in a revealed preference experiment, touches upon the socialist debate. It thus touches upon one of the most fundamental questions in mechanism design, and political economy: "Why do centralized mechanisms and de-centralized markets co-exist?". Our experiment shows that participation constraints already create problems in small groups with small stakes. The difficulties of negotiating a public project on the scale of a company, or nation, would seem close to insurmountable if unanimity (voluntary participation by all parties) is required (see also Mailath and Postlewaite, 1990). Centralized organizations with coercive power, like the state or the company, are able to force participation on individual projects. In effect, these organizations allow groups to bundle decisions and projects and take the individual projects away from purely decentralized mechanisms like open markets. Centralization and bundling ensures the projects can jointly happen with full participation, even if participation constraints could have prevented the individual projects from occurring in a decentralized mechanism. In our experiment, groups would have been better off if they could have agreed to use AGV or SM on all projects, rather than the zero-implementation mechanism every time someone objected. So individual participants could have accepted that they would be forced to participate in AGV or SM mechanisms on some projects that are against their interest, and overall be better off than not getting any project implemented in a decentralized setting. Similarly, in society and in companies the gains in efficiency from extra investment in common projects are large enough to compensate participants for their involvement in projects or decisions that are not individually rational to them. Our findings thus give one reason for the existence of states and organizations with coercive power. Although a centralized state might not be as efficient in dealing with (local) incentive constraints as the market, it makes dealing with the participation constraints on individual projects a lot easier. In the words of one of the classics in this debate (Clarke, 1971, p. 17): "If policing and exchange costs associated with a market arrangement are too high, substitute non - market devices may be preferred".

Our data allows us to 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. 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 asymmetric pattern is present in all treatments and across a number of 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 familiar SM mechanism. In order to have a “fair” comparison, of efficiency as well as participation preferences, it might be necessary to provide subjects with more opportunities to learn how the AGV actually works. Given that we do not familiarize our subjects with the AGV, 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. More effort is required to identify mechanisms that are both empirically robust and acceptable alternatives to the participants.

Our setup allows us to vary individual participation constraints and to compare the preference for mechanisms before and after private information is received in a revealed preference setting. The crispness of the results are a clear indication of the strength of the setup. We believe the method by which participation constraints are measured and varied could be fruitfully applied to experimentally investigate other questions surrounding participation constraints, for instance in optimal auctions, monopoly pricing or matching settings. Furthermore, in our experiment we compare the achieved efficiency of 2 of the most important mechanisms in social choice, the optimal AGV and the empirically extremely common majority voting mechanism, to see how efficient they are in a controlled setting. The test of the AGV and SM shows that both mechanisms do not perform as well as theory predicts, and more importantly, that behavior of the simple voting mechanism is more robust than that of the AGV and the achieved efficiency can show a different ranking than theory predicts. The reversal of theoretical predictions clearly indicates that experimental tests of proposed mechanisms are needed to find better mechanisms for a specific situation or context.

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Declarations

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Conflicts of interest/Competing interests

Authors do not have any conflicts of interest to declare.

Availability of data and material (data transparency)

Data and code used in analysis is available from the authors, and can be stored in journal's repository if this is desirable.

A Appendix

A.1 Derivation of predictions

A.1.1 Prediction 1

Note that all mechanisms generate as much surplus as is generated by the public project, 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 the preference of individuals without private information for the AGV over NSQ and RAND mechanism in prediction 1. 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 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 4.6875%, such that the expected loss of the SM mechanism relative to first-best efficiency 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 4.6875%, 9.375%, 4.6875% and 4.6875% 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 4.6875%, 9.375%, 4.6875% and 4.6875% 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 1.

A.1.2 Prediction 2

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 $M \in \{\text{NSQ}, \ \text{RAND}, \ \text{SM}\}$. With a negative private value, v_i, the best response is to choose the mechanism with the lowest probability of implementation. Since $\Pr(\text{Y=1} \mid \Gamma = \text{NSQ}) = 0$, the NSQ (weakly) dominates $\{\text{RAND}, \ \text{SM}\}$ for these individuals. For the AGV mechanism, we also have to verify that the transfers do not change this prediction. The expected transfer, in truth-telling Bayes-Nash equilibrium in the symmetric treatment is -0.125€ for the statements 3 and -3 and +0.125€ for -1 and 1. For the AGV, the lowest implementation probability is achieved by any given subject by stating claiming the lowest type. Note, however, that this yields a probability of implementation that is strictly greater than 0 and a negative expected transfer, such that no rational individual with a negative valuation would choose this strategy over NSQ. Choosing AGV and playing claiming type -1 in the AGV yields an expected transfer of 0.13 [0.23] (0.23) € in the symmetric [-7] (+7) treatment, but increases the implementation probability to 37.5% [37.5%] (50%) (assuming a truthful strategy of the other players). With any negative value in our distributions the expected implementation costs are therefore higher than the transfers. Hence this strategy is also not preferred to the NSQ. Since the transfers achieve their maximum at the -1 report, while the probability of implementation keeps increasing in the reported valuation, this also rules out any strategy with a higher reported type. Hence, also in the comparison between AGV and NSQ, types with a negative valuation prefer the NSQ. In fact, the expected transfers for types with a negative valuation are never large enough to change the preferences over mechanisms. A similar line of reasoning proves the same result for types with positive valuations.

A.1.3 Predictions 3 and 4

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

$$E(U) = v_i * Pr(Y = 1 | \ \Gamma = M, \ v_i).$$

In the AGV the expected payoff is additionally influenced by the expected transfer each individual has to pay/receives, so it becomes:

$$E(U|AGV) = v_i * Pr(Y = 1 | \ \Gamma = AGV, \ v_i) + E(t_i | m_i = v_i).$$

Where t_i is the transfer and m_i the message send by the subject about her type. Since the individuals possess private information, this can be either 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 8 below.

Table 8: 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 Segal and Whinston (2016) showed more generally, 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 all 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 - Choices in all treatments

Figures 6 (left-skewed treatment) and 7 (right-skewed treatment) below show all choices made in the first block ex ante (rounds 1-6) and ad interim between NSQ and the other mechanisms.

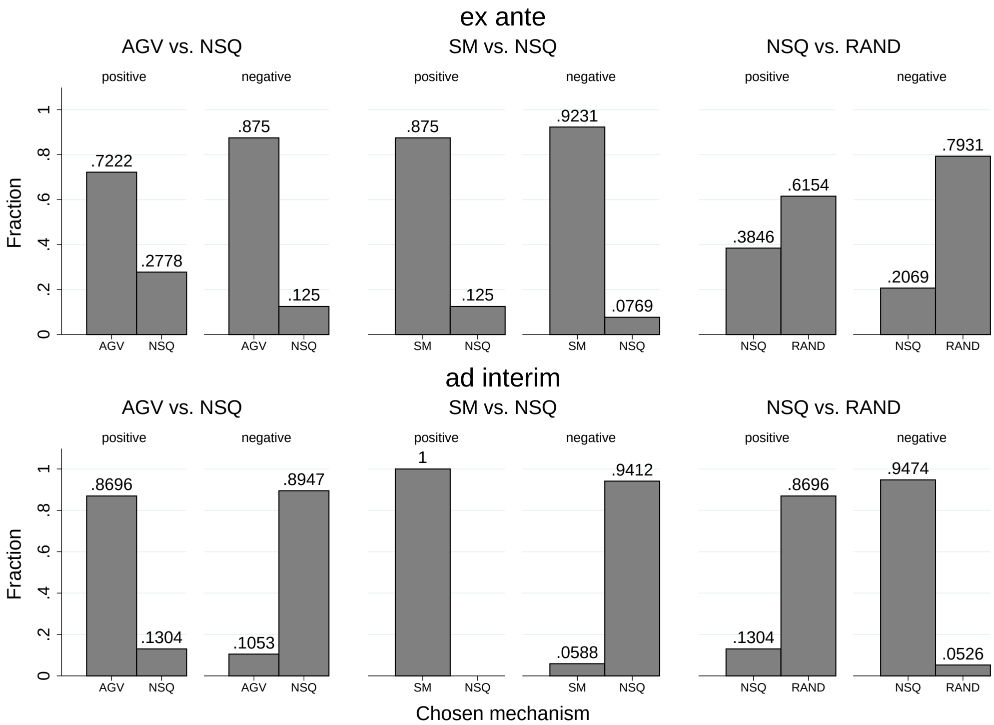


Figure 6: Mechanism choice by private valuation (right-skewed treatment)

In Table 9 the results for all binary comparisons in the first ex-ante round (block 1: round 1-6) 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, block 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.

In Table 10 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 sub-

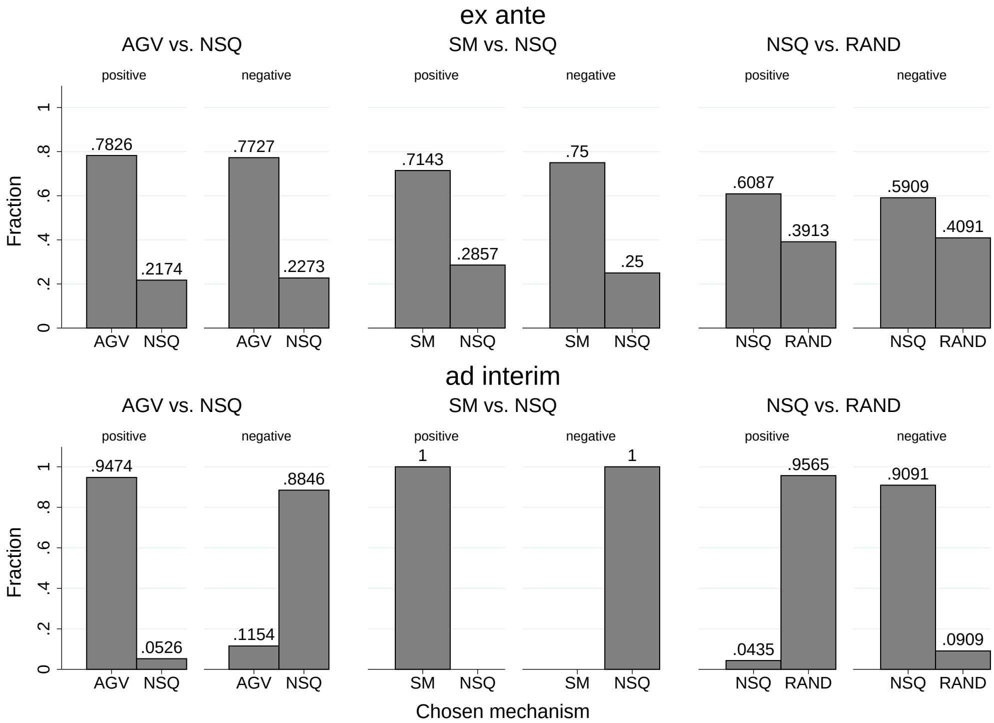


Figure 7: Mechanism choice by private valuation (left-skewed treatment)

Table 9: Percentage of subjects who 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							
block 1	45	SM (69%)	AGV (78%)	AGV (76%)	SM (89%)	SM (89%)	RAND (53%)
block 2	45	SM (60%)	AGV (76%)	AGV (87%)	SM (87%)	SM (84%)	NSQ (62%)
right skewed (+7)							
block 1	42	SM (55%)	AGV (81%)	AGV (79%)	SM (90%)	SM (88%)	RAND (74%)
block 2	42	SM (62%)	AGV (83%)	AGV (90%)	SM (90%)	SM (88%)	RAND (69%)
left skewed (-7)							
block 1	45	AGV (69%)	AGV (78%)	AGV (82%)	SM (73%)	SM (93%)	NSQ (60%)
block 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.

jects with a valuation of +3 chose the AGV mechanism over the SM mechanism (consequently 2 of 13 subjects selected the SM mechanism).

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

Table 10: Proportion of subjects who 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 who 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.

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 one 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 chooses 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.

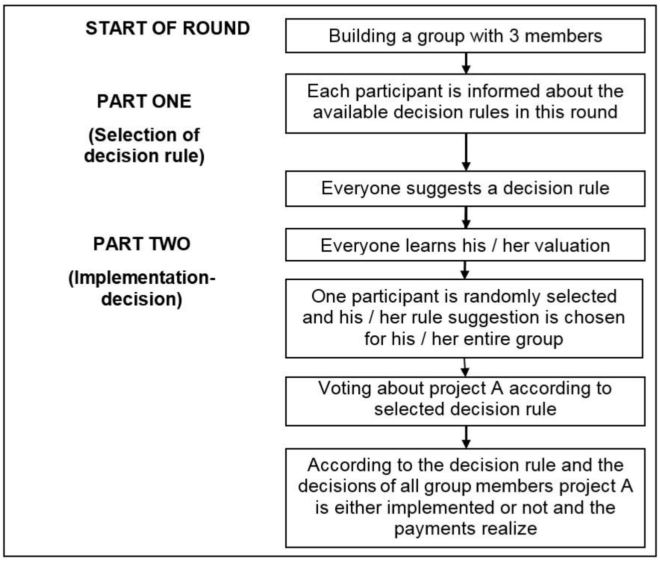
Please note that you will know your exact valuation for the project, but not the valuations of the other group members. The valuation of each group member can be -3€, -1€, +1€ or +3€. All values are equally likely. The values are independently distributed, such that your valuation in one round does not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

A.3.1 Transfer tables used in the experimental instructions

Since the only real difference between the treatments in the type space used and the transfers in the AGV that different type reports cause, translations of the transfer tables from the instructions are reproduced below. The transfers of the symmetric treatment can be found in the sample instructions above.

Table 11: Transfers in the right-skewed treatment

Stated valuations of the other group members:										
Your statement:	**7, 7**	**1, 7 or 7, 1**	**-1, 7 or 7, -1**	**-1, 1 or 1, -1**	**-1, -1**	**7, -3 or -3, 7**	**1, -3 or -3, 1**	**-1, -3 or -3, -1**	**1, 1**	**-3, -3**
7	0	-0.42	-0.42	-0.84	-0.84	-0.375	-0.79	-0.79	-0.84	-0.75
1	0.84	0.42	0.42	0	0	0.46	0.04	0.04	0	0.08
-1	0.84	0.42	0.42	0	0	0.46	0.04	0.04	0	0.08
-3	0.75	0.33	0.33	-0.08	-0.08	0.375	-0.04	-0.04	-0.08	0

Table 12: Transfers in the left-skewed treatment

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, -7 or -7, 3**	**1, -7 or -7, 1**	**-1, -7 or -7, -1**	**1, 1**	**-7, -7**
3	0	-0.04	-0.04	-0.08	-0.08	0.375	0.33	0.33	-0.08	0.75
1	0.08	0.04	0.04	0	0	0.46	0.42	0.42	0	0.84
-1	0.08	0.04	0.04	0	0	0.46	0.42	0.42	0	0.84
-7	-0.75	-0.79	-0.79	-0.84	-0.84	-0.375	-0.42	-0.42	-0.84	0

Table 13: Transfers in the robustness treatment

Stated valuations of the other group members:										
Your statement:	**7, 7**	**-1, 7 or 7, -1**	**-2, 7 or 7, -2**	**-3, 7 or 7, -3**	**-1, -1**	**-2, -1 or -1, -2**	**-1, -3 or -3, -1**	**-2, -3 or -3, -2**	**-2, -2**	**-3, -3**
7	0	-0.75	-0.75	-0.75	-1.5	-1.5	-1.5	-1.5	-1.5	-1.5
-1	1.5	0.75	0.75	0.75	0	0	0	0	0	0
-2	1.5	0.75	0.75	0.75	0	0	0	0	0	0
-3	1.5	0.75	0.75	0.75	0	0	0	0	0	0

A.4 Screen shots

The following Figures 8 to 13 show original screen shots of the German zTree program. All screen shots are from the symmetric treatment.

Figure 8: Screen shot: Mechanism choice in ex-ante round

Figure 9: Screen shot: Voting in the SM Mechanism

Figure 10: Screen shot: Feedback in the SM Mechanism

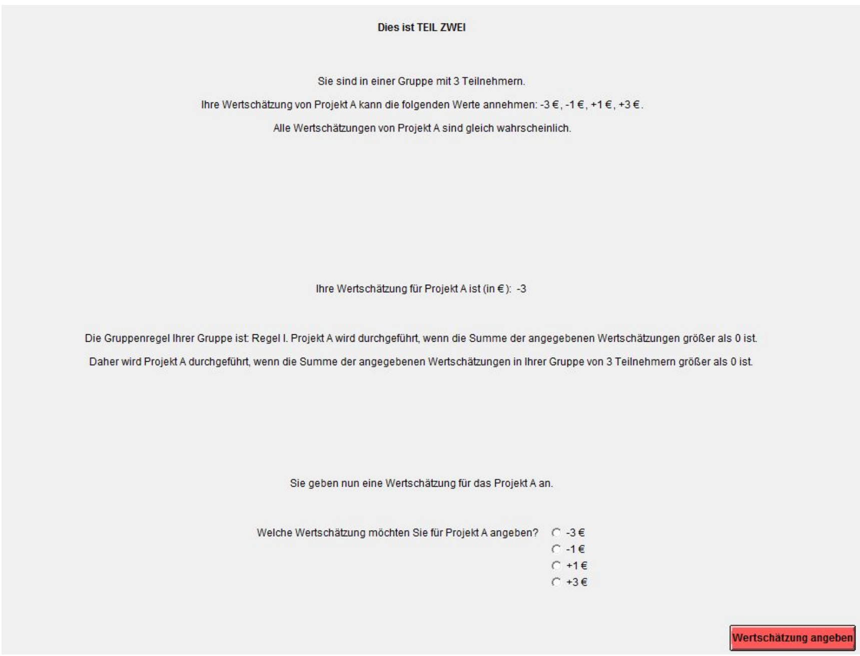


Figure 11: Screen shot: Reporting valuation in AGV Mechanism

Figure 12: Screen shot: Feedback in the AGV Mechanism

Figure 13: Screen shot: Mechanism choice in ad-interim round