Focusing climate negotiations on a uniform common commitment can promote cooperation

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International cooperation on the reduction of greenhouse gas emissions, disarmament, or free trade needs to be negotiated. The success of such negotiations depends on how they are designed. In the context of international climate change policy, it has been proposed [e.g., M. L. Weitzman *J. Assoc. Environ. Resour. Econ. 1, 29–49* (2014)] that shifting the negotiation focus to a uniform common commitment (such as a uniform minimum carbon price) would lead to more ambitious cooperation. Yet, a proof-of-concept for this important claim is lacking. Based on game theoretical analyses, we present experimental evidence that strongly supports this conjecture. In our study, human subjects negotiate contributions to a public good. Subjects differ in their benefits and costs of cooperation. Participation in the negotiations and all commitments are voluntary. We consider treatments in which agreements are enforceable, and treatments in which they have to be self-enforcing. In both situations, negotiating a uniform common commitment is more successful in promoting cooperation than negotiating individual commitments (as in the Paris Agreement) and complex common commitments that tailor the commitment to the specific situation of each party (as attempted with the Kyoto Protocol). Furthermore, as suggested by our model, a uniform common commitment benefits most from being enforced.

negotiation design | cooperation | common commitment | reciprocity | climate policy

International cooperation on climate change, free trade, and disarmament requires successful negotiations about how much each party contributes to the public good. The success or failure of these negotiations depends on how they are designed (1). Particularly, in the context of international climate change policy, it has been hypothesized that negotiating a uniform common commitment would be more successful in achieving cooperation than negotiating individual or complex common commitments (2–5). Yet, a proof-of-concept for this important claim is lacking. Using a laboratory experiment with human subjects and a game theoretical analysis, we fill the gap—and provide strong support for the conjecture.

We consider a canonical public good problem. Asymmetry is known to be an essential complication to international agreements (6), so—besides a control with fully symmetric parties—negotiators in our main laboratory treatment differ in their initial endowment, in how much they benefit from the public good, and in how much of it they want to be provided. Lack of enforcement is another fundamental problem that hinders international cooperation (7–9), so we look at a situation where parties can write a binding and enforceable contract and at a situation where the agreement has to be self-enforcing. Negotiations differ in two dimensions. First, parties can negotiate a common goal to be achieved either by individual commitments (each party deciding individually how much to contribute) or by a common commitment (all parties deciding jointly and unanimously on all contributions). Second, a common commitment may be achieved either by a complex assignment (tailoring each individual contribution to its individual costs and benefits) or by a uniform rule (disregarding individual differences). In all treatments, participation in the negotiation and commitments are voluntary.

We find that negotiation design is of first-order importance. If negotiations are focused on a uniform common commitment, contribution levels are about twice as high compared to negotiations focusing on individual or complex common commitments. Negotiating a complex common commitment is slightly more successful at the extensive margin by inducing more parties to participate, but it is dominated at the intensive margin by the uniform commitment because negotiators often fail to coordinate any agreement. Negotiating individual commitments is equally as successful as a uniform common commitment in getting parties to participate, but again at substantially lower contribution levels. One reason for the superior performance at the intensive margin is that negotiating a uniform common commitment turns (reciprocal) cooperation into a weakly dominant strategy for all participating parties. The results are robust and hold not only in the case where contracts are binding and enforceable (as predicted by theory) but even in the case where agreements cannot be enforced but have to be self-enforceable (in which case, standard game theory predicts zero cooperation across all treatments).

Our study is motivated by, and potentially important for, international negotiations on climate change (5). There have been two major approaches to negotiating international climate cooperation. In the Kyoto negotiations, the developed countries

Significance

Climate change and other threats to modern societies require international cooperation. Utilizing a laboratory experiment and game theoretical analysis, we find that the success of negotiations to promote cooperation strongly depends on the kind of commitment negotiated. In the context of international climate policy, our findings indicate that individual commitments (as negotiated in the Paris Agreement) and complex common commitments (as negotiated in the Kyoto Protocol) tend to have only limited success in promoting cooperation. Shifting the negotiation focus to a uniform common commitment, such as a minimum carbon price, may potentially foster more ambitious cooperation and thus help mitigating climate change.

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strived for a complex assignment of national emission caps. However, no such assignment (that the negotiating parties could all agree upon) has been found. Eventually, each country chose its emission cap individually, which then became part of the Kyoto Protocol (4, 10). Some countries later withdrew from the Kyoto Protocol, others did not live up to their promises, and a planned follow-up protocol was never ratified.

In the Paris negotiations, instead of attempting a common commitment, each country pledged an individually chosen commitment ("nationally determined contributions"). The Paris Agreement succeeded in being signed by all countries (although the United States decided later to withdraw its participation). However, the announced individual commitments fall substantially short of achieving the two-degree goal (11, 12).

There is a new proposal that negotiations should focus on a common carbon price (2, 3, 13, 14). Previous authors advocated carbon pricing as an instrument to implement the reduction of carbon emissions at low economic cost (15, 16). The new proposal points to a different and independent argument: A carbon price provides a simple focal point for a common commitment in climate negotiations—one number that applies to all countries in the same way. This facilitates agreement (17) and fosters reciprocity (2, 3, 14, 18, 19) which is key to cooperation (20–24). Yet, evidence showing that negotiating a uniform carbon price can be more successful than negotiating a vector of emissions caps (as in Kyoto) or nationally determined contributions (as in Paris) is lacking.

This paper provides evidence, based on experimental and game theoretical analyses, that a uniform common commitment better promotes cooperation than the alternative commitments. The advantage of a laboratory experiment is that it allows study of the negotiation outcomes after exogenous changes in the negotiation design, as well as the mechanisms that causally drive behavior. While all theory and experiments necessarily abstract from many real-world complexities, our study informs the important debate about how to approach climate negotiations by providing a proof-of-concept, experimentally and theoretically, that negotiating a uniform common commitment may be more successful than previous negotiation designs.

Experiment Design and Related Studies

The human subject experiment builds on a linear one-shot public good game with four parties who differ in their initial endowments and the costs and benefits of their investments into a common project (see *SI Appendix* for details). The experiment is framed neutrally. If applied to climate change negotiations, the investments can be interpreted as emission reductions or carbon prices, but there was no reference to climate change in the experiment. In this game, it is a dominant strategy for each party not to invest anything into the common project, but all parties are better off if all invest.

The public good game is preceded by a three-stage negotiation procedure. At the first stage, all parties decide simultaneously whether to participate in the negotiation. At the second stage, participants make publicly displayed proposals for a potential agreement. Each party can replace its current proposal with a new proposal at any time. At the third stage, they can simultaneously commit to an agreement.

After the negotiation, all parties decide simultaneously how much to invest in the public good. In the treatments with enforcement, parties who committed to an agreement in the negotiation phase must match or exceed their commitments, while nonparticipants and participants who did not reach an agreement can choose any investment they like. In the treatments with no enforcement, all parties are unconstrained in choosing their investment level, no matter whether they participated in an agreement.

We compare three negotiation designs that differ in what is being negotiated. In *Individual Commitment* (IC), each participant proposes how much she is willing to invest. While she may also propose how much each other participant should invest, the final, binding proposal is only for her own, individual commitment. In *Complex Common Commitment* (CCC), each participant proposes how much each party should invest. The final proposal specifies the vector of investments, one investment for each of the participants. It becomes a binding commitment if and only if all participants agree to the same vector, implying that each negotiator has the power to veto any given proposal. In *Uniform Common Commitment* (UCC), each participant proposes a uniform minimum investment for all participants. By participating, the parties agree that the lowest of all proposals (i.e., the least cooperative proposal) becomes binding for all participants. No party can be committed to a higher contribution than its own proposal. For more details on the experimental procedures, see *Materials and Methods*.

Our study is closely related to an important experimental literature on minimum contributions in public good games (25), because our uniform commitment treatment imposes a minimum contribution level. This literature mostly corroborates our finding that imposing a minimum contribution is effective in promoting cooperation, and it does so under various laboratory conditions. For instance, it has been shown that a minimum contribution level may promote cooperation 1) regardless of whether it is imposed endogenously, exogenously, or by a central authority (26, 27); 2) for a variety of payoff functions including concave ones (28); and 3) under various forms of payoff asymmetries among subjects (29–32). A few studies mention potential challenges. For instance, there is evidence that, in specific circumstances, a minimum contribution level might crowd out contributions of otherwise cooperative subjects, yet other experiments find no or only small crowding out (27, 28, 33). Other studies come to mixed conclusions regarding subjects' willingness to voluntarily participate in coalitions to provide the public good (34, 35). Finally, a related theoretical literature studies the effectiveness of commitment devices absent strong institutions, such as through the usage of deposits (36). Our study contributes to this literature by comparing the effectiveness of UCC negotiations with both IC and CCC negotiations, and by studying how these three negotiation designs differ regarding participation decisions and enforcement. It is designed to capture some of the key features of the three leading approaches to negotiating climate cooperation that have been implemented or proposed.

Game-Theoretic Analysis and Predictions

A game-theoretic analysis of the treatments with enforcement, assuming that all parties are rational and purely self-interested, predicts that the success of climate negotiations depends on the negotiation design (for the full analysis, see *SI Appendix*, section S2). In IC, because commitments are individual and nonreciprocal, it is a dominant strategy for each party to commit to an investment level of zero. In stark contrast, in UCC, there is a unique Nash equilibrium in weakly dominant strategies that achieves the socially efficient outcome if at least three parties participate in the negotiations. This is because the participant proposing the lowest uniform commitment determines the outcome. Assuming that enough parties participate, if this participant raises her proposed commitment, she raises it for all participants, making herself (and everybody else) better off. Thus, each participant is predicted to propose the commitment level that she would like to be imposed on all participants. At the same time, high investment proposals are protected against exploitation, because nobody has to invest more than any other

participant. In this sense, UCC successfully builds reciprocity ("I will if you will") into the negotiation design.

Finally, in CCC, there are multiple equilibria. If at least three parties participate in the negotiations, almost any vector of investments is a Nash equilibrium in the negotiation subgame. No standard refinement selects one of these equilibria as the most plausible one to be played. While there are many equilibria yielding an efficient outcome, none of them gives rise to equal payoffs. Without a focal point for an agreement, coordination is difficult (2, 17). Each negotiator prefers an agreement in which others are committed to invest more and she herself is committed to invest less. Whether parties are able to solve this coordination problem is an empirical question that is addressed by our experiments.

Based on the game-theoretic analysis of the experiment with enforcement, we predict IC negotiations to be least effective and UCC negotiations to be very effective. The efficiency of the CCC negotiations may equal that of IC or UCC or be somewhere in between. At the same time, however, more-effective negotiation designs tend to give stronger incentives to free ride by not participating in the negotiations in the first place. A party that does not participate in the negotiations benefits from the commitment of the negotiators, while she is free to choose how much to invest herself. This may mitigate the success of effective negotiation design.

On the other hand, there is reason to expect that the participation rate will be high in all treatments, including UCC. A large body of behavioral and experimental research shows that many people are "conditional cooperators," willing to invest more than predicted by pure self-interest if others invest as well (37–39). It has been suggested that conditional cooperators are also more willing (than predicted by their narrow self-interest) to participate in institutions that promote cooperation (35).

In the treatments with no enforcement, parties have to rely on nonbinding agreements. Here the assumption that all parties are rational and purely self-interested implies that agreements are cheap talk and that nobody will invest anything in the common project no matter what the negotiation design. However, behavioral economics, economic psychology, and experimental evidence suggest that nonbinding agreements and promises do affect behavior (40, 41).

Results

Fig. 1 shows the results of the experiment with enforcement and confirms that negotiation design strongly affects negotiated outcomes. Cooperation levels, as measured by commitments and actual investments (averaged over all subjects), are much higher in UCC compared to IC and CCC. The average commitment measured in percent of the socially optimal level is almost twice as high in UCC (73%) as in IC (40%) and CCC (33%). All differences are statistically significant. The average investment in UCC is even higher, 83% of the social optimum, while the investments in IC and CCC reach only 45% and 48%, respectively. This difference is again statistically highly significant, while the difference between IC and CCC is not statistically significant. See *SI Appendix*, section S3 for the full statistical analysis.

The game-theoretic analysis assumes that all people are purely self-interested. Therefore, it predicts that IC yields zero investments and that investments should never exceed commitments. Fig. 1 shows, however, that IC is, to some extent, effective and that, in all three treatments, some subjects invest more than they are committed to do. This is consistent with overwhelming evidence that many people (and countries) are not purely self-interested, but are willing to make voluntary contributions to the public good (12, 42). However, the data also show that this motivation alone falls substantially short of achieving the socially efficient outcome.

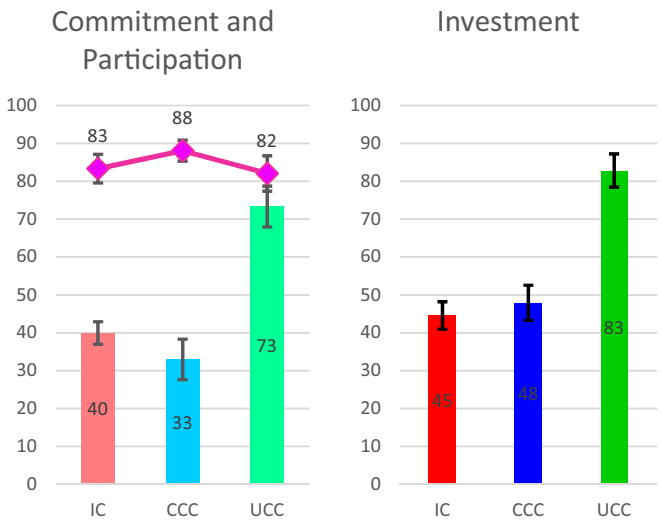

Fig. 1. Enforcement treatments: cooperation measured by commitments, participation, and investments across negotiation treatments when contracts are enforced. The bars display the average commitments (*Left*) and investments (*Right*) in percent of the socially optimal investment level in the three treatments. The averages are calculated with respect to the whole group of subjects, regardless of whether subjects participated in the negotiation or not, thus illustrating the groups' overall cooperation level. The violet diamonds above the bars in *Left* display the participation rates. Error bars represent SE of the mean clustered at the matching group level. The results are based on 1,060 observations of commitment, investment, and participation decisions of 212 individuals. Each individual participated in one treatment only and took decisions in five anonymous and randomly rematched groups.

Because UCC is so effective in achieving cooperation of the parties that participate in negotiations, it could also be more susceptible to free riding by nonparticipants. Yet, the participation rate in UCC is, with 82%, almost as high as in IC (83%). The rate in CCC is with 88% statistically significantly higher, but the difference is small in absolute terms. Thus, as shown in Fig. 1, differences in participation rates do not impede the effectiveness of UCC.

Two other factors are decisive for the superior performance of UCC, illustrated by Fig. 2. The first is the choice of commitment levels by the negotiating parties. The reciprocal nature of UCC negotiations creates incentives to choose the socially optimal commitment if the coalition size is sufficiently large. Indeed, overall, UCC negotiators commit to an average of 89% of the socially optimal investment. If all four parties participate in the negotiations, UCC negotiators reach almost full efficiency (96%; Fig. 2). If CCC negotiators come to an agreement, they reach a significantly lower level of efficiency (87% on average), but this is still much higher than the average commitment for IC negotiators of only 48%.

The second factor is the likelihood that any given group of negotiators will reach an agreement. Because there are many efficient and inefficient equilibrium agreements in CCC, coordination is difficult. Indeed, on average, only 43% of all CCC negotiations result in a common commitment, with little variation across coalition sizes (see purple diamonds in Fig. 2). The failure to successfully coordinate in complex negotiations reduces the overall commitment level in CCC (averaged across all negotiators) to 37%. On the other hand, there is always an agreement in IC and UCC. By definition, the individual commitments in IC do not require coordination. UCC negotiations impose the rule that the lowest proposed investment level

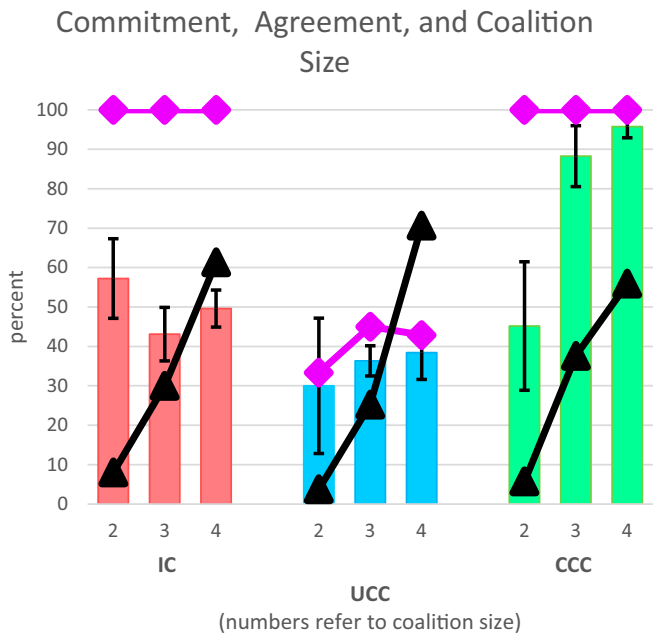

Fig. 2. Inside negotiations: commitment, agreement, and coalition size when contracts are enforced. The bars show average commitments (in percent of the socially optimal investment level) conditional on participation as a function of the coalition size in each treatment. In contrast to Fig. 1, subjects who did not participate in negotiations are not included. Error bars represent SE of the mean clustered at the matching group level. The commitment levels in UCC are generally much higher than the commitment levels in IC and CCC. The black triangles show the distribution of the number of participants in negotiations ("coalition size"). In all treatments, larger coalitions are much more frequent than smaller coalitions. The purple diamonds show the frequency of agreements for different coalition sizes. Full agreement is built into IC and UCC, while CCC negotiations fail in more than half of all cases. This is the main reason for the poor performance of CCC. In those cases where an agreement is reached, commitments in CCC reach, on average, 87% of the efficient level.

becomes binding for all participants, so an agreement to the lowest common denominator is always reached.*

We conclude that, while (on average) IC fails to promote individual cooperation and CCC fails to promote coordination, UCC achieves both agreement and high investment levels.

Robustness: No Enforcement Treatment and Additional Results. For international agreements, enforcement is an important challenge. Although some enforcement is often possible (e.g., through shaming, the threat of retaliation in repeated interaction, or just because sticking to one's previous commitments and promises in negotiations is "the right thing to do") (8, 9), it cannot be taken for granted. Thus, as a robustness check, we conducted a stress test of our institutions, where agreements are not binding and can be violated at no cost. In the treatments without enforcement, investment levels are lower, as expected. But, surprisingly, our qualitative results are unaffected (Fig. 3). Parties invested 52% of the efficient level in UCC but only 34% in both IC and CCC. This not only refutes the standard game-theoretic prediction of no investments in all three treatments, it also shows that negotiation design systematically affects cooperation even when agreements are nonbinding, just as in the treatments with enforcement. A possible explanation is given by recent results in behavioral economics on promises and honesty (40, 41, 43). When people are given an opportunity to increase their payoff by breaking a promise, some of them do, but many do not or do not fully exploit the opportunities for cheating (44). As a result, nonbinding agreements do affect behavior, but they are not as powerful as enforceable contracts.

From our treatments with and without enforcement, we conclude that negotiating a uniform commitment is much more successful in promoting cooperation than the alternative negotiation designs. Even without enforcement, a uniform common commitment achieves significantly higher average investments than individual commitments and common complex commitments with enforcement. Moreover, UCC benefits most from an enforcement technology: Enforcement increases investments by 31 percentage points in UCC, but only by 11 and 14 percentage points in IC and CCC, respectively. That is, while enforcement is clearly important, it is not sufficient to achieve cooperation. Rather, its effectiveness—in line with our theoretical analysis—depends on negotiation design.

Our results and interpretations are also robust to learning and variations in the (as)symmetry of parties. In all treatments, subjects interacted anonymously over five rounds. In each round, groups were randomly rematched (stranger treatment). If we look at the behavior over time, we find a small negative time trend for investments, very similar in all treatments, of about two percentage points per period. There is no time trend in participation decisions in any of the treatments (*SI Appendix*, section S3).

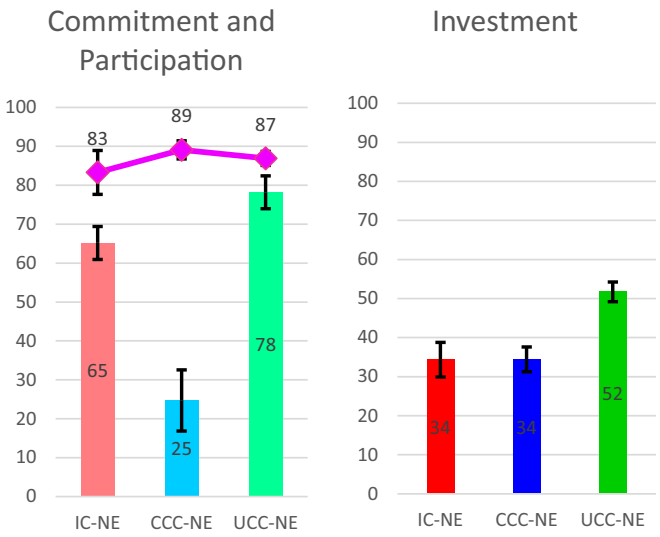

Fig. 3. No enforcement (NE) treatments: cooperation measured by nonbinding commitments, participation, and investments across negotiation treatments when there is no enforcement. Fig. 3 corresponds to Fig. 1, but without enforcement. The bars display the average nonbinding commitments (*Left*) and investments (*Right*) in percent of the socially optimal investment level in the three treatments. Because, in this treatment, commitments are not enforced, they are denoted as "nonbinding commitments." The averages are calculated with respect to the whole group of subjects, regardless of whether subjects participated in the negotiation or not, thus illustrating the groups' overall cooperation level. The violet diamonds above the bars in *Left* display the participation rates. Error bars represent SE of the mean clustered at the matching group level. The results are based on 760 observations of commitment, investment, and participation decisions of 152 individuals. Each individual participated in one treatment only and took decisions in five anonymous and randomly rematched groups.

*Even though participants often failed to reach an agreement in CCC, lack of negotiation time does not seem to have been the critical issue. We asked subjects after the experiment whether they felt that more time would have been needed. On a scale from 1 ("do not agree at all") to 7 ("fully agree"), a large majority of 62.5% answered with 1 or 2, while only 12.5% answered with 6 or 7. Perhaps not surprisingly, the average answer in IC (2, 3) and UCC (1, 2) was even lower than in CCC (2.72), but not by much.

In an additional experiment, we consider a symmetric public good game (with enforcement) in which all four parties have the same payoff function (see *SI Appendix*, sections S2 and S3, for details). Without asymmetries, a natural focal point for cooperation is equal and efficient investments, which removes the complexity of CCC negotiations and thus mitigates one key difference between UCC and CCC. In fact, while the participation rates are somewhat smaller than in the baseline, overall investment levels are now very similar in UCC (57%) and CCC (58%, no statistically significant difference), but still significantly smaller in IC (41%). This shows that the lack of a focal point in the asymmetric CCC negotiations is the main driver for the superior performance of UCC in the baseline experiment (see *SI Appendix*, section S3).

Conclusions

Our study provides causal evidence that a negotiation design that focuses on a uniform common commitment can be more successful in achieving cooperation than individual commitments or complex common commitments. Negotiating a uniform common commitment is superior in our experiments both when agreements are binding and when they are not. Moreover, as predicted by theory and confirmed by the experiments, when enforcement is available, it can most effectively promote cooperation when negotiators focus on a uniform common commitment.

Because our laboratory study controls away potentially confounding factors in the world outside the laboratory, we caution that, of course, one cannot conclude from our study that switching the negotiation style will automatically lead to more cooperation in the real world. For instance, the number of parties in the negotiation might differently affect the effectiveness of each of the negotiation designs, which, in turn, might affect the number of parties that should be invited to the negotiations. We leave such questions to future studies.

That said, our study complements previous discussions and previous evidence in several, less-controlled field studies suggesting that reciprocal common commitments may indeed be crucial for achieving cooperation (4, 20, 45). It also offers a proof-of-concept for a key negotiation design choice when the goal of the negotiation is to promote cooperation.

The Paris Agreement will be reviewed and further developed in the future. How to achieve more ambitious cooperation will be an important concern in this process. Our study suggests that parties should consider shifting a focus of the negotiations to a uniform, reciprocal target. One natural candidate would be a uniform minimum price for carbon emissions. It is a simple and transparent policy instrument that is relatively easy to measure and to compare across countries, and can be flexibly implemented with taxes, markets for emission rights, or hybrid policies (24). Because a uniform price minimizes total costs of reducing CO_2 emissions, it is also a widely accepted goal already, supported by advocates of a carbon tax as well as by promoters of cap-and-trade.

While our experiments exogenously imposed the kind of contract that could be agreed upon, it would be interesting to study the choice of agreement that negotiators strive for (27, 32), and how this depends on the problem under consideration. For price agreements, it often seems natural to look for a uniform common commitment that applies the same price to all parties, such as a uniform minimum price for carbon, a uniform minimum tax on corporate profits, or a uniform maximum tariff on imports. In other contexts, however, a uniform proportional rule may be more appropriate. For instance, countries may wish to contribute to a Green Fund in proportion to their GDP or to their cumulative carbon emissions in the past. We must leave such questions to future research.

An important concern is that, with 192 countries, there will always be some countries that are unwilling to support an ambitious climate policy, for political or economic reasons. Integrating these parties in an international agreement based on the lowest common denominator, as stipulated by the unanimity rule of our UCC design, would impede any cooperation. Thus, as forcefully advocated by Nordhaus (5, 14), it may be preferable to start out negotiating a uniform carbon price within a "climate club" of some of the main players (e.g., the United States, Europe, China, and Japan), and to extend the carbon price to other countries using sticks (e.g., border adjustment taxes) and carrots (e.g., support through a Green Fund) at a later stage.

Materials and Methods

The experiment (including six pilot sessions) was preregistered at AsPredicted.org (*SI Appendix*, section S5). This research was approved by the Institutional Review Board ("Ethics committee" of the Faculty of Economics) at the University of Munich where the study was conducted, and it included informed consent by all participants (*SI Appendix*, section S6). It took place at the Munich Experimental Laboratory for Economic and Social Sciences in Munich in 2018. There were 23 sessions, each divided into two matching groups, and 500 participants in total. Sessions lasted about 90 min and yielded average earnings of €19.91 (approximately $24.00). *SI Appendix*, Table S1 displays the demographic summary statistics of all experimental sessions.

Subjects interacted anonymously via a computer network. After reading the instructions and answering test questions, the subjects played the negotiation game five times with random rematching within each matching group after each period ("stranger condition"). Then they had to complete a short questionnaire. Finally, the computer randomly selected one period for payment (see *SI Appendix*, S7 for the full text of the instructions).

In the experiment with enforcement, four parties can write a binding contract on "investments" in a public good, called "group project." If investments $x_i \in [0, x_i^{max}]$, $i \in \{A, \ldots, D\}$, are made, the payoff of party i is given by

$$U_i = w_i - x_i + a_i \cdot \begin{cases} \sum_{j=1}^{4} x_j, \text{ if } \sum_{j=1}^{4} x_j \le \overline{X}_i \\ \overline{X}_i, \text{ if } \sum_{j=1}^{4} x_j > \overline{X}_i, \end{cases}$$

where w_i is the initial endowment, $a_i < 1$ is the marginal individual return of the investment, and $\overline{X}_i$ is the maximum total investment above which further investments are no longer beneficial for party i. The values of these parameters are summarized in *SI Appendix*, Table S2. Total surplus is maximized if $\sum_{j=1}^{4} x_j = 300$. The investments can be interpreted as emission reductions or carbon prices. However, the experiment is framed neutrally without any reference to climate change.

Before investment decisions are made, parties can negotiate a binding contract as described above. At the negotiation stage, all participating parties can make proposals and counterproposals for 3 min in real time. If a proposal is made, all parties see the proposal along with the payoff consequences implied by the proposal.

If a contract is agreed upon, each contracting party has to invest at least the amount it committed to in the contract. A party that did not participate in the negotiations can choose any investment level $x_i \in [0, x_i^{max}]$.

The experiment with no enforcement is identical to the experiment with enforcement with the only exception that the "contract" is called an "agreement" and that it is common knowledge that this agreement is not enforced. Thus, at the investment stage, all parties can choose any investment level $x_i \in [0, x_i^{max}]$.

Finally, we conducted a control experiment with symmetric parties that has the exact same structure as the experiment with enforcement, but here all four parties have the same endowments and payoff functions that are the averages of the parameters of the asymmetric treatments (*SI Appendix*, Table S2).

Data Availability. Datasets, code, and do-files have been deposited in Economics & Business Data Center (https://doi.org/10.7805/climate-negotiations) (46).

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