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Pledges and how social influence shapes their effectiveness

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ABSTRACT

Pledges are used to signal the intention to act in a socially desirable way. In this study, we examine what role social influence plays in the decision to pledge. In a laboratory experiment, subjects can make a pledge to contribute to a public good in the socially optimal way. Across treatment conditions, we vary the way in which the pledges are elicited. Hence, the degree of social influence on pledge-making is manipulated and its impact can be examined. We find that when individuals are aware that the majority of other subjects decided to pledge, they are likely to conform and also make the pledge. The emergence of such a critical mass can be stimulated by (institutional) design, namely by determining the elicitation order on the basis of previous behavior. Overall, this commitment nudge is effective. Both socially-oriented and previously not socially-oriented subjects modify their behavior after the pledge.

1. Introduction

Non-binding pledges receive increasing attention as a policy instrument to promote socially desirable behavior, such as e.g. contributions to the public good of climate protection. For example, the European Commission aims, as part of its European Climate Pact, to *"encourage people and organisations to commit to concrete actions, designed to reduce their greenhouse gas emissions and/or adapt to the inevitable impacts of climate change. The Commission will promote pledges (public commitments) (…) to boost their impact and inspire further action"* (European Commission, 2020). Similarly, pledging initiatives can be observed in schools, universities or organizations in which members are encouraged to make public commitments about sustainable behavior, thus fostering individual pro-social and pro-environmental actions and establishing a corresponding social norm (Bicchieri, 2002; Nyborg et al., 2016; Ostrom, 2000).[1] Given the growing interest in pledges, we believe it is important to understand what determines the effectiveness of pledges in inducing socially desired behavior in social dilemma situations. Specifically, we are interested in how social influence affects the decision to pledge and the corresponding behavioral responses.

Existing experimental research has shown that voluntary pledges, although non-binding, can induce cooperative behavior in social dilemmas. Pledges can help groups to coordinate on collectively optimal behavior and facilitate cooperation (Isaac & Walker, 1988; Orbell, Dawes & van de Kragt, 1990; Sally, 1995). While previous studies have examined the impact of the nature of the decision situation and the

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[1] As examples may serve the sustainability pledges of Michigan State University or the City Vernon (Canada), with which citizens commit to act more sustainable. On the organizational level, companies commit in pledging initiatives like The Climate Pledge or RE100 to be net zero carbon by 2040, or switch to 100% renewable electricity. Lastly, nations pledge in the UN Climate Change Conferences by how much they intend to reduce their greenhouse gas emissions and until when, an application example that has motivated early experimental work on pledges (e.g Barrett and Dannenberg 2016).

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properties of pledges, social influence also plays a determining role for the effectiveness of pledges. We understand as social influence the way others' behavior or thinking influences own decision-making. In pledging initiatives, like the above-mentioned, actors rarely decide simultaneously whether to pledge, but some make the pledge decision earlier, which others can observe before they decide about the pledge themselves. Hence, not every pledge-maker makes a pledge purely out of intrinsic interest in the stated behavior, but some may also be prompted to pledge upon observing others having made the pledge and thus conform (Asch, 1955; Banerjee, 1992; Bernheim, 1994).

Using the controlled setting of a laboratory experiment, we examine how social influence affects the effectiveness of pledges to promote socially desirable behavior in a public good setting. Specifically, by modifying the sequential elicitation order, we control (i) what information *followers* receive about the pledging decision of their group members and (ii) which subjects make as *first movers* the decision about the pledge. Further, we test whether these modifications in the elicitation order impact subsequent contribution behavior. In previous experiments, the pledge decisions were either elicited simultaneously (Barrett & Dannenberg, 2016; Dannenberg, 2015b; Koessler, Page & Dulleck, 2021) or pledges arose endogenously in free-text communication (Bicchieri, 2002; Orbell et al., 1990; Orbell, van de Kragt & Dawes, 1988). Consequently, social influence as a determinant of pledging behavior has not yet been systematically analyzed.

Contrary to previous studies on conformity, the interventions to alter social influence in this study do not target behavior directly, but an antecedent and non-binding declaration of intent. Nevertheless, we find the public commitment affects the subsequent behavior of pledge-makers. If carefully crafted elicitations of commitments motivate more people to pledge, and this expression of intent can also bring about a change in behavior, then an effective mechanism has been found for promoting pro-social and pro-environmental behavior.

The remainder of this paper is organized as follows: In Section 2, relevant insights from existing research are summarized. In Section 3, the experimental design is presented and behavioral predictions are derived. The experimental results are presented in Section 4. Section 5 concludes the paper with a discussion of the results and their implications for policy and practice.

2. Related literature: the effect of pledges and social influence on social dilemma behavior

Many daily problems are characterised by a social dilemma structure; individually optimal behavior leads to socially suboptimal outcomes. The social sciences, and in particular the experimental social sciences, have a long tradition of investigating conditions under which cooperation in such social dilemmas is supported. Pre-play communication is one of these conditions (Chaudhuri, 2011), and early communication experiments already point to the important role of pledges in such communication (Bicchieri, 2002; Isaac & Walker, 1988; Orbell et al., 1988, 1990). Subsequent studies identified pledges as a stand-alone means of promoting cooperation, and examined whether, and under what conditions, announcements of intended contributions alone can help to motivate higher contributions to public goods. An initial finding of this research is that pledges can only be effective if they are credible, i.e. the pledge is understood as a signal of the true intentions of an actor (Barrett & Dannenberg, 2016; Bochet & Putterman, 2009; Dannenberg, 2015a). If, on the other hand, interaction partners discover that the pledged and realized behavior differ, the pledge loses its effectiveness and can even be counterproductive for cooperation (Wilson & Sell, 1997). Moreover, early studies indicate that pledges are most effective in promoting cooperation when players make uniformly the pledge to cooperate (Orbell et al., 1988, 1990).

Voluntary pledges are associated with a strong selection effect, that is socially-oriented players who exhibit high rates of cooperation are more likely to make the pledge (Ismayilov & Potters, 2016; Koessler et al., 2021). As individuals strive to maintain a positive self-concept and social image (Bénabou & Tirole, 2006; Mazar, Amir & Ariely, 2008), actors, once they have made a pledge, are likely to meet the promised behavior.[2]

But why should individuals make a pledge in the first place? First, the actor might have an intrinsic preference for social behavior and is interested in communicating it. So, the pledge is an expression of her intentions and self-image. In social settings, the pledge serves as a signal for her social image (Bénabou & Tirole, 2006; Ellingsen & Johannesson, 2007). Considering that the actor operates in a social space, two more motives are conceivable. The actor may understand the pledge as a strategic signal and thus aims to induce behavioral change in others by altering their beliefs about the collective behavior in the future (Bénabou, Falk & Tirole, 2018; Foerster & van der Weele, 2021; Hagenbach & Koessler, 2010).[3] Or, and this aspect has not yet been systematically analyzed, the actor is influenced in her decision to pledge by the decisions of others. In reality, actors often know how others have decided before they decide themselves to make a public commitment. This social information is likely to influence the actor's decision on the pledge. Social influence can go so far that the *'individual expresses a particular opinion or behavior in order to fit in to a given situation or to meet the expectations of a given other, though he does not necessarily hold that opinion or believe that the behavior is appropriate'* (Ritzer, 2007). This means that in sequential decision-making situations, when actors observe the behavior of others before making their own decision, they may imitate their predecessors, although they might have decided differently on their own. The literature sees the reasons for this, on the one hand, in the provided information. Individuals 'mimick' others' behavior to take advantage of their (potential) better information base. In a world of uncertainty, following others also implies to reduce risk of getting sanctioned for violating the norm. On the other hand, a second stream of literature, originating in social psychology, sees a general human inclination to follow the behavior of others and to feel discomfort when standing out (Asch, 1955; Bernheim, 1994; Cialdini & Goldstein, 2004). For both explanations applies, when the behavior of others can be observed, it impacts own decision-making[4] – an aspect we examine in this study in the context of pledge-making and consequent behavioral change.

Lastly, our research links to leadership studies in which single players exert influence on others. These first movers can either lead by example, i.e. the players make costly commitments in the form of actual contributions (Dannenberg, 2015a; Güth, Levati, Sutter & van der Heijden, 2007), or lead by words, i.e. the players send non-binding messages to other group members (Houser, Levy, Padgitt, Peart & Xiao, 2014; Wilson & Sell, 1997). Studies comparing the two forms do not give a consistent picture. Sahin, Eckel and Komai (2015) find that neither of the leadership institutions is effective in increasing contributions in a linear public good game. Pogrebna, Krantz, Schade and Keser (2011) find that both leadership styles increase average contributions to a similar extent. Dannenberg (2015a) finds that leading by example is more effective, but if subjects have a choice, the majority prefers to lead by words or not at all. This is in turn in line with Güth et al. (2007), who show that only a few groups succeed in installing a leader endogenously, although groups with leaders perform better. So even if actions are more effective in leading groups to higher

[2] The literature examining the effect of pledges in bilateral interactions discusses three potential motives as to why actors want to act consistently with their promise, (a) due to a personal preference to keep one's (Ellingsen & Johannesson, 2004; Vanberg, 2008), (b) not wanting to go against the social norm of keeping a promise (Bicchieri & Lev-On, 2007; Binmore, 2006), and (c) due to guilt aversion based on the expectations one has created in others through the pledge (Charness & Dufwenberg, 2006).

[3] Being conditional co-operators and understanding the pledge as a credible signal of true intentions, the other actors should adapt their behavior accordingly.

[4] See, for example, Steiger and Zultan (2014) who investigated the impact of sequential contribution mechanisms and varying information schemes in public good games.

Table 1
Treatments.

Group		Description	Subjects	Groups
Control		Control group	96	24
Pledging treatments	*Simultaneous*	Simultaneous pledge	96	24
	SQ.Random	Pledging order randomly determined	96	24
	SQ.Average	Pledging order determined based on previous average contributions	96	24
	SQ.Endog	Pledging order determined endogenously	96	24
Total			480	120

contribution levels, it is not easy to find actors who are willing to do so. In this research, we do not explicitly study leadership, but rather the wider role of social influence on the announcement of intentions and consequent behavior in social dilemma situations. This means, in the present study, not only *first movers* express unilaterally how they wish to proceed, but all players. As a consequence, the effectiveness of the pledge stems and depends on the possible coordination among all group members. If a critical mass of pledge-supporters can be found ex ante, 'words' may in this case be a powerful guide for group behavior.[5]

3. Experimental design

The experiment is based on a two-stage design. All subjects played first the standard public good game (baseline stage), then groups were randomly reshuffled and the treatments were installed before the second stage started. This two-stage design allows to capture individual heterogeneities in the initial contribution behavior.

3.1. The baseline stage

Subjects were randomly paired in groups of four and played the standard linear public good game (with a voluntary contribution mechanism) for ten rounds (Ledyard, 1995). The framing of the game was kept neutral, the matching groups remained fixed, and players were identifiable by constant player labels.

In each round, subjects were equipped with 20 experimental taler (game currency) and were asked how they wanted to allocate the endowment between a private and a public account with which a common project was financed. Money assigned to the personal account turned into personal earnings. Money assigned to the public account was summed up and multiplied by a factor of 1.6, and the resulting amount was equally distributed among all members of the group. While the social optimum was to contribute the entire endowment, the Nash equilibrium was to contribute nothing and free-ride on the contributions of others. The payoff function of the individual player was: $\pi_i = (20 - c_i) + 0.4 \sum^{4}_{j=1} c_j$.

Thereupon, subjects were informed about the individual contributions of each group member and received feedback on their (potential) payoff from this round. At the end of both stages, only one round was randomly selected to determine the payoff for the contribution decision and belief entry.

3.2. The second stage

After the tenth round, subjects were informed that the first part of the experiment was over and that new groups were formed, following perfect stranger matching, in which the ten rounds of the second stage would be played. The task, however, would be the same as in the first stage. Subjects in the *Control* group then confirmed their participation for a second time, with a consent statement. In the four *Pledging treatment* groups (*Simultaneous, SQ.Random, SQ.Endog* and *SQ.Average*), subjects learned about the possibility of making a public declaration about socially-optimal contributions prior to the start of play. It was made clear that the declaration was voluntary, would neither affect the later decision options nor the payoff structure, and that the one-time pledge would apply to all contribution rounds in Stage 2. This design feature allows us to later examine how long the effect of the pledge lasted. Before the first contribution decision was due, subjects were informed how many players in their group made the pledge and that pledge-makers would be identifiable by a coloured label in all the following rounds.

Pledging was undertaken in two steps. Subjects were asked whether they wanted to make the pledge and if so, they had to type the following statement: *'I promise to contribute 20 taler in each of the following rounds'*.[6] Players thus pledged to contribute their full endowment, i.e. the socially optimal contribution. Table 1 provides an overview of the treatment groups and observation numbers.

In the treatment group *Simultaneous*, subjects were simultaneously asked to make a decision about the pledge. In the three sequential treatment groups, the elicitation of the pledge was either done in turn or the order developed endogenously within the groups. What subjects in all sequential treatment groups had in common was that they knew how many previous players had made a pledge decision and how they decided before making the pledge decision themselves.

In *SQ.Random,* the order in which subjects were asked about the pledge was assigned randomly. In *SQ.Average,* the decision order was determined based on subject's average contributions in the first stage, with those subjects being asked first whose previous contributions were the highest in the new matching groups. This selection mechanism was unknown to the subjects. In *SQ.Endog,* no decision order was given, and subjects could make the decision about the pledge when they wanted to. The instructions only stated that all group members had to make a decision – regardless of whether they wanted to make the pledge or not – before the game could continue. Once a player made a decision, it was shown to all group members in real time. All game instructions can be found in the supplementary material.

The experiment was conducted at the experimental laboratory of Osnabruck University using the experimental software SoPHIE (Hendriks, 2012). Subjects were students recruited from the local database of potential subjects via ORSEE (Greiner, 2015). Average earnings were 12 €uro and a session lasted about one hour. The instructions are accessible in the online supplementary material:https://osf.io/7dex4/?view_only=d5d2a462f48846948c3f65e23b1116ae

4. Behavioral predictions

Under the assumption that individuals are only interested in maximizing their own profits, players would always make the pledge to motivate their group members to contribute, but never contribute to the public good themselves. However, assuming common rationality, the other players would be aware of these true intentions and would not attach importance to the declaration. Following this logic, pledges

[5] Besancenot and Vranceanu (2021) provide suggestive evidence from a two-player setting that these words may also influence decisions. In their pledge and give game, players adjusted their decision to donate to charity following a non-binding donation announcement from the other player.

[6] If subjects decided against the declaration, it was common knowledge that they would then need to type in the consent statement a second time. The consent statement was similar in length to the pledge, so that no consequences could be drawn from the typing behavior of the other participants.

would be cheap talk and would not alter the prediction of rational choice that no contributions will be made to the public good.

The results of a myriad of empirical studies, however, contradict this prediction. Players contribute, in general, between 40% and 60% of their endowment to the public good, and communication prior to the start of the game can increase contributions significantly (Chaudhuri, 2011). In addition, contributions are conditional. Fischbacher, Gächter and Fehr (2001) demonstrate that a high proportion of individuals act as conditional co-operators, meaning that contribution behavior correlates strongly with a subject's beliefs about how much others will contribute. Thus, cooperation is belief-dependent. Some players are only willing to contribute (on high levels), when they believe that others do so as well. Communication in general, and a pledge in specific, can prompt such a change in beliefs, if it is understood as a credible signal of other players' intention to contribute (Bicchieri, 2002; Orbell et al., 1988). Pledges then can be more than cheap talk, but a powerful coordination device to induce behavioral change. As outlined in previous work (Koessler et al., 2021), the effect of pledges stem from (i) inducing a commitment effect[7] and (ii) from shifting beliefs about future behavior and thus easing coordination for socially optimal outcomes among the group members. For the present work, we hypothesize that particularly the latter coordination effect is stronger the more individuals make the pledge. The more uniformly a group takes the pledge, the stronger are the associated beliefs about high future group contributions and thus the cooperation norm (Bicchieri, 2002; Rege & Telle, 2004). This, in addition to their own commitment, encourages individuals to contribute on high levels.

Prediction 1 - Salience: A large proportion of pledge-makers in a group is associated with a higher level of average group contributions.

Support for this prediction is found in the early studies of Orbell et al. (1988, 1990), in which the authors show that pledges in open communication are particularly effective in increasing contributions when all group members make the pledge.

The second interest of our research, assuming Prediction 1 is true, is then how higher uniformity in the pledging decision can be reached. A finding from previous research gives direction in this regard. It has been shown that pledges are more likely to be made by subjects who generally act in a more socially-oriented way, i.e. they contribute more than others to the public good (Ismayilov & Potters, 2016; Koessler et al., 2021; Koessler, Torgler, Feld & Frey, 2019). Therefore, we hypothesize that when subjects who contributed most in the baseline stage are asked first about the pledge, they are highly likely to make the pledge. Further, we expect that when no decision order is determined, previously over-average contributing subjects move first and make the pledge.

Prediction 2a – Social Leaders in SQ.Avg: If individuals who contributed previously high amounts to the public good are asked first about the pledge, they are more likely to make the pledge than a randomly selected player.

Prediction 2b – Social Leaders in SQ.Endog: When no decision order is determined, individuals who have previously contributed on a high level are likely to be the first to pledge .

As stated earlier, individuals have a tendency to follow others and mimic the actions of predecessors (Banerjee, 1992; Bikhchandani, Hirshleifer & Welch, 1992). Consequently, a cascading effect can unfold when a critical mass of pledge-makers is established in a group. Then, the actor not only commits herself, but also passes on this commitment to the next in line (Bénabou et al., 2018). Following this, we hypothesize that if a critical mass of pledge-makers is established in a group, i.e. the majority of previous movers made the pledge, subsequent players conform and also make the pledge.

Prediction 3 – Social influence: When an individual observes that the majority of previously asked group members made the pledge, she is more likely to also make the pledge.

This dynamic is independent from how the pledges were elicited. However, following the two former predictions, it can be expected that in *SQ.Average* and *SQ.Endog* pledge-makers will more often be in the majority among the group members than in the other treatment groups.

Prediction 4a – Elicitation based on previous behavior: When the decision order of the pledges is based on the level of previous contributions, pledge-making is likely to be more frequent than when the pledge is elicited randomly.

Prediction 4b – Endogenous elicitation order: When the decision order of the pledges is not determined, pledge-making is more frequent than when the pledge is elicited randomly.

When individuals make a promise, it is likely that they follow through on it, so as to maintain a positive self and social image (Bénabou & Tirole, 2006; Mazar et al., 2008) and not to experience internal disutility from not keeping a promise (Charness & Dufwenberg, 2006; Ellingsen & Johannesson, 2004; Vanberg, 2008). The commitment effect is strengthened when the individual observes that also others announce the same intention. As a result, her beliefs about the future contribution behavior of others shift and lead to the aforementioned coordination effect. The more unanimous a group takes the pledge, the clearer is thus the descriptive and injunctive expectations of contributing on high levels (Bicchieri, 2002; Rege & Telle, 2004).

Prediction 5 – Effect on contribution behavior: Since significantly more pledges are made in *SQ.Average*, the resulting contributions in this treatment group are higher than under other elicitation schemes.

Lastly, we will examine the reactions of low contributors. This group is not intrinsically motivated to act pro-socially, but according to Prediction 3 makes the pledge when facing a critical mass of previous pledge-makers. Since the pledge comes at no financial cost, low contributors also pledge at this stage and thus avoid standing out and possibly spoiling the motivation of fellow group members to contribute on high levels.

Prediction 6 - Low contributors: Individuals who previously showed no interest in contributing on a high level to the public good, make the pledge when exposed to a majority of other pledge-makers.

The interesting question is whether these low-contributors will also change their behavior after the non-binding pledge. They may have pledged for purely strategic reasons, i.e. to persuade their group members to make high contributions, with no intention of meeting the pledge themselves. Or they may have been nudged to pledge by social influence and, having learned about the unanimity of the pledge decision in their group, adapt the new behavioral standard.[8] In short, predictions about the consequent behavior of low-contributors are speculative and the question must be answered empirically.

5. Results

This result section is structured in two parts. First, we present the results of the *pledging decisions*, then, in the second part, we analyze what effect the pledges have on *contribution behavior*. Hereby, we pay special attention to subjects who contributed low amounts in the baseline stage but then pledged to contribute the socially-optimal amount in the second stage.

[7] This commitment can stem from an individual's preference to keep a promise (Ellingsen & Johannesson, 2004; Vanberg, 2008) and/or maintaining a positive self-concept and social image (Mazar et al., 2008, Bénabou & Tirole, 2006).

[8] Exemplary studies which have shown that cooperation can be successfully boosted by interventions inducing a new frame and thus a new social norm of cooperation are e.g. Rege and Telle (2004), Dufwenberg et al. (2011) or Barron and Nurminen (2020).

Table 2
Treatment effects on the likelihood of pledging.

	(1)	(2)			(3)	(4)
Variables			***Pledging likelihood***			
			[Corresponding decisions in treatment group Simultaneous serve as reference]			
SQ.Random	0.001	0.025	***First movers***	*SQ.Random*	−0.022	−0.018
	(0.087)	(0.084)			(0.111)	(0.109)
SQ.Endog	−0.078	−0.077		*SQ.Endog*	0.054	−0.007
	(0.124)	(0.128)			(0.147)	(0.149)
SQ.Average	0.185***	0.166**		*SQ.Average*	0.249**	0.058
	(0.078)	(0.076)			(0.123)	(0.129)
			Followers *information about decision of other group members available*	*SQ.Rand* × Pledge_preexist ≥ 50%	0.108	0.152
					(0.099)	(0.094)
				SQ.Endog × Pledge_preexist ≥ 50%	−0.083	−0.074
					(0.126)	(0.128)
				SQ.Avg × Pledge_preexist ≥ 50%	0.238***	0.255***
					(0.095)	(0.091)
				SQ.Rand × Pledge_preexist < 50%	−0.129	−0.112
					(0.109)	(0.113)
				SQ.Endog × Pledge_preexist < 50%	−0.114	−0.075
					(0.136)	(0.132)
				SQ.Avg × Pledge_preexist < 50%	0.035	0.086
					(0.176)	(0.187)
Contrib_Avg1		0.039***				0.042***
		(0.008)				(0.009)
Otherscontr_Avg1		−0.006*				−0.006*
		(0.003)				(0.003)
Demogr. controls	yes	yes			yes	yes
Observations	384	384			384	384

Notes: This table presents the average marginal effects (calculated at means of all variables) from probit regressions on the likelihood of making a pledge. The pledging behavior in `Simultaneous' serves as a reference point. In this treatment group, no information on the pledging decision of other group members was available before the subject's own pledging decision. 'Pledge_preexist ≥ 50%' is a dummy variable that takes the value of one when a subject in the sequential treatments (SQ.Random, SQ.Endog or SQ.Avg) faced a critical mass of pledge-makers, i.e. the majority of the previous players made the pledge. 'Pledge_preexist < 50%' is a dummy variable that takes the value of one when the subject faced the situation that less than half of the previous players made the pledge. A subject's previous average contribution level is taken into consideration with 'Contrib_Avg1′. 'Otherscontrib_Avg1′ accounts for the average contribution level a subject observed other players contributed in her or his matching group in the baseline stage. All models include experimenter fixed effects. Robust standard errors, clustered at group level, are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

5.1. Pledge-making

When the pledging decision was elicited simultaneously, 61.46% of the subjects decided to make the declaration compared to 60.42% when the elicitation order was random (*SQ.Random*). Hence, no significant difference in the pledging likelihood between *Simultaneous* vs. *SQ. Random* was observed (Pearson χ^2 test*:* $\chi^2 = 0.022$, $p = 0.882$). Also in *SQ.Endog*, where individuals decided themselves at what point they wanted to make the decision about the pledge, the pledging rate of 59.38% is similar to the rate in the two previous settings (Comparison with *Simultaneous:* $\chi^2 = 0.087$, $p = 0.768$; with *SQ.Random:* $\chi^2 = 0.022$, $p = 0.883$). When, however, the decision order was determined by the average contributions in the baseline stage, significantly more subjects made the pledge, specifically 80.21% in *SQ.Average* (Comparison with *Simultaneous*: $\chi^2 = 8.168$, $p = 0.004$, with *SQ.Random* $\chi^2 = 9.007$, $p = 0.003$; with *SQ.Endog:* $\chi^2 = 9.882$, $p = 0.002$).

Moreover, in the *SQ.Average* treatment group, pledge-makers formed the majority in most matching groups (see Fig. A1 in the appendix). In *SQ.Average,* it was observed that in 54% of the groups all group members made the pledge and in 75% of the groups, the pledge-makers constituted the majority, i.e. three or more group members made the pledge. In *SQ.Random,* in contrast, pledge-makers were in the majority only in 58% of the groups. In *Simultaneous* and, surprisingly, also in *SQ.Endog*, pledge-makers formed the majority only in 42% of the groups. We thus find support for Prediction 4a:

Result 1: When pledges were elicited sequentially, with the order based on previous contribution levels, pledging was more common and pledge-makers formed the majority in more matching groups.

This means our treatment manipulation was successful; by using previous contributions as a proxy for the willingness to pledge and aligning the elicitation order accordingly, we could create a trend of pledge making and thereby heighten the likelihood of players making the pledge.[9] But, this manipulation also implies that the social information which low and high contributors received about the behavior of others differed strongly across the treatment groups. In multivariate regression analyzes we account for these differences. Table 2 presents the corresponding results of a probit regression model estimating the likelihood of a subject making the pledge. At first, in Model 1, we replicate the results from the non-parametric tests. Pledge-making in *SQ. Average* is significantly more likely than under all other treatment conditions ($p < 0.01$). Since no significant difference in the pledging likelihood is found among the other pledging treatment conditions, we find first evidence that Prediction 4b cannot be sustained; when group members decide themselves on the pledging order, pledge-making is not more frequent than when the pledge is elicited randomly.

Model 2 accounts for the average contribution levels of individuals before the pledge ('Contrib_Avg1'), and the average contribution level observed by an individual to have been contributed by other group members in Stage 1 ('Otherscontrib_Avg1'). By controlling for these factors, the coefficient describing the additional increase in the pledging likelihood in *SQ.Average* becomes smaller, but the difference is still highly significant compared to the pledging likelihood in *Simultaneous* ($p = 0.011$) or in the two other sequential elicitation schemes (for the comparison with *SQ.Random:* $p = 0.041$; for the comparison with *SQ. Endog:* $p = 0.021$). Furthermore, the finding from previous studies is replicated: subjects who previously contributed more to the public good

[9] Table AI in the appendix shows the corresponding average contribution levels from the first stage once for all players and once for only the pledge-makers in each treatment group.

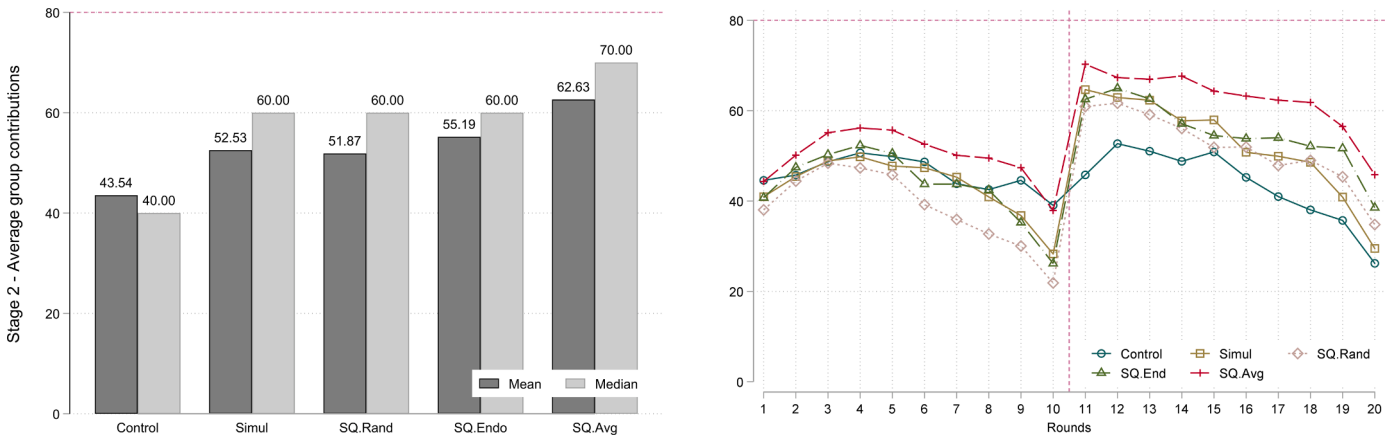

Fig. 1. Group contributions in Stage 2. The left-hand panel shows the group contribution per treatment group in Stage 2 (after the pledge). The right-hand panel shows the development of average group contributions over time in Stage 1 and 2.

were more likely to make the pledge.

Models 3 and 4 focus on the social influence aspect and take into account what social information was available to the decision-makers. Thus, the likelihood of pledge-making is estimated for three subgroups. First, for the individuals who were first in their group to decide on the pledge (*first movers*). This group had no information about the other group members' decisions when making the pledge. Second, for all group members who were not first movers *(followers)*. In this group, we additionally differentiate subjects according to the information they received about the decisions of their group members who made the pledging decision before them, i.e. we take into account what social influence they were subject to. This results in two type of followers: (i) subjects who observed that previous players predominantly decided to make the pledge ('pledge_preexist ≥ 50%'), and (ii) subjects who observed that previous players predominantly decided against the pledge ('pledge_preexist < 50%'). The pledging likelihood of all three subgroups is estimated against the pledging likelihood in *Simultaneous*. Hence, the two dummy variables for the impact of social information do not cancel each other out.

5.1.1. *Pledging decisions of first movers*

Focusing only on the first movers (Model 3), we see that they were again most likely to pledge when the elicitation order was based on previous average contribution levels. In *SQ.Average,* first movers were significantly more likely to make the pledge than when the pledge was elicited simultaneously (H0: *SQ.Average* = *Simultaneous*:. $p = 0.044$) or in random order (H0: *SQ.Average* = *SQ.Random:* $p = 0.067$). We thus find support for Prediction 2a. When high-contributing individuals got asked first about the pledge, it was more likely that the first pledging decision was positive. In *SQ.Endog,* where it was up to the group members to determine the decision order, we expected as part of Prediction 2b, that high-contributing individuals would also be the first group members to make the pledge. However, interestingly, this is not the case: the pledging likelihood of first movers in *SQ.Endog* was slightly higher than in *Simultaneous* or *SQ.Random,* but not in a statistically significant manner ($p = 0.712$ and $p = 0.666$, respectively).

By constructing a variable which simulates the selection process in *SQ.Average,* thus a variable which ranks the players in their Stage 2 matching group according to their average contributions in Stage 1, we find that the first movers in *SQ.Endog* were more heterogeneous than expected. Only 37.5% of the first movers in *SQ.Endog* would have been asked first if the decision order had been based on previous average contributions. Thus, in sum, Prediction 2b is not supported. Once the decision order was left to the group, it was no longer a given that previous high contributors acted first and made the pledge.

Result 2: (a) When individuals who had previously contributed to the public good at a high level were asked first whether they wanted to make a pledge about socially optimal contributions in the future, they largely agreed. As a result, the first decision on the pledge was significantly more often positive than when a randomly selected person was asked first. (b) If, on contrast, it was left to the individuals to decide on a pledging order, former high contributors did not necessarily act first.

Finally, Model 4 shows that once one controls for the previous average contributions on which the selection mechanism in *SQ.Average* was based, the pledging likelihood in *SQ.Average* is no longer statistically different to the likelihood in the other treatment groups.

5.1.2. *Pledging decisions of followers*

In the group of *followers*, we are particularly interested in the situation when subjects faced a critical mass of pledge-makers, i. e. the majority of predecessors made the pledge ('pledge_preexist ≥ 50%'). In *SQ. Average,* this exposure stimulated pledging significantly. Subjects were 24 percentage points more likely to pledge than their counterparts in *Simultaneous* which did not receive this information ($p = 0.013$ in Model 3 and $p = 0.005$ in Model 4, respectively). In *SQ.Random,* the information also exerted a positive influence, but not in a statistically significant manner. Hence, for the treatment group *SQ.Average,* Prediction 3 is supported.

Result 3: When an individual observed that the majority of previously asked group members made the pledge, she was more likely to also make the pledge.

In *SQ.Endog,* on contrast, the information that former players predominantly made the pledge did not increase the likelihood of followers making the pledge. If anything, the social information reduced the probability. This represents a significant difference to the effect the same message had in *SQ.Average* ($p = 0.012$ in Model 3 and $p = 0.014$ in Model 4, respectively). To examine why the response to the social information differed, it helps to break down the pledging decisions by the decision order and pre-existing amount of pledge-makers. Table A2 in the appendix shows the respective likelihoods of observing a pledge in each treatment group. Based on this analysis, two observations can be made. First, players were generally more likely to make a pledge when previous players had done so; this reaffirms the social influence effect described in Result 3. Second, as seen previously, the proportion of first movers making the pledge differed across the treatment groups. In *SQ. Average*, 83% of first movers decided to make the pledge. In *SQ.Endog*, the proportion was with 71% lower[10] and this gap widened in succeeding rounds. In each elicitation round, fewer players were willing to

[10] In *SQ.Random* (58%) the proportion was similar to the overall pledging proportion in *Simultaneous* (61%).

Table 3
Tobit estimation of 1st round contributions after the pledge.

	(1)	(2)	(3)		(4)				
VARIABLES			*Contribution in first round after pledge*						
Simultaneous	14.223***	2.347*	**N° of Pledge-makers** in matching group	**0**	−0.857	**Subject decided** not to make the pledge	**N° of Pledge-makers** in matching group	**0**	−1.156
	(2.258)	(1.286)			(1.558)				(1.366)
SQ.Random	12.270***	0.246		**1**	2.658**			**1**	−0.736
	(2.589)	(1.660)			(1.277)				(1.305)
SQ.Endog	11.706***	2.209		**2**	8.522***			**2**	1.994
	(2.807)	(1.636)			(1.345)				(1.441)
SQ.Average	16.949***	−0.278		**3**	16.572***			**3**	4.242**
	(2.915)	(2.253)			(1.541)				(1.956)
				4	31.265***				
					(4.552)				
Simul × Pledge-maker		62.453***				**Subject** decided to make the pledge (Pledge-maker)	**N° of other Pledge-makers** in matching group	**0**	15.671***
		(4.523)							(3.523)
SQ.Rand × Pledge-maker		22.112***						**1**	17.938***
		(2.896)							(2.771)
SQ.Endo × Pledge-maker		20.087***						**2**	26.043***
		(3.175)							(3.511)
SQ.Avg × Pledge-maker		23.647***						**3**	27.018***
		(3.552)							(3.825)
Contrib_Avg1	2.249***	1.634***			1.819***				1.571***
	(0.260)	(0.185)			(0.228)				(0.179)
Otherscontrib_Avg1	−0.306***	−0.203***			−0.235***				−0.183***
	(0.094)	(0.060)			(0.081)				(0.059)
Constant	−2.580	0.601			−0.219				0.626
	(2.128)	(1.649)			(1.818)				(1.624)
Observations	480	480			480				480

Notes: This table presents the results of a Tobit regression on contributions in the first round of Stage 2, i.e. directly after the pledging decision. The variables *Simultaneous, SQ.Random, SQ.Endog* and *SQ.Average* are dummy variables that take the value one in the corresponding treatments, and zero otherwise. 'N° Pledge-makers' accounts for the amount of Pledge-makers in one's matching group. 'N° Pledge Others' accounts for the number of other Pledge-makers. The interaction with 'Pledge-maker' estimates the change in contributions for individuals who decided to pledge separately. All models include experimenter fixed effects. Robust standard errors, clustered on the group level, are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

make the pledge in *SQ.Endog* than in the analogous setting of *SQ.Average.* In consequence, pledging in *SQ.Endog* was less unanimous. In fact, the probability of observing unanimous pledge-making across all predecessors was with 54% significantly higher in *SQ.Average*, than in *SQ.Endog*, where the probability was 36% (prtest: $z = -2.465$, $p = 0.014$). As a result, the pledge in *SQ.Endog* constituted a weaker signal for a new cooperation norm. Furthermore, examining Table A2, one finds that even for the same constellations – same rank in elicitation order and same amount of previous pledge-makers – followers in *SQ.Endog* were less inclined to follow the predominant pledging behavior they observed in others. It seems the structure in *SQ.Endog* made them more idiosyncratic. In sum, this means we do not find support for Prediction 4b.

Result 4: Letting subjects decide themselves when to make the pledge reduces the effectiveness of the pledges as coordination mechanism.

5.2. Behavior after pledging

This section examines whether and how the promised behavior carried over to actual contribution behavior. First, the *average* group contributions across the treatments are compared. After, we investigate changes in individuals' contribution behavior, controlling for the subject's and other group members' pledging decisions, as well as their previous contribution behavior.

The left-hand panel in Fig. 1 shows the mean and median of group contributions in Stage 2 across the treatment groups. Average contributions are clearly higher when a pledging option is available. Using average group contributions across rounds as the unit of observation, a Mann-Whitney-U test (MWU) reveals that, in *SQ.Endog* and *SQ.Average,* the pledging intervention led to a significant improvement in comparison to the contributions in the *Contro*l group ($p = 0.036$ and $p = 0.002$, respectively). In *Simultaneous*, contributions also increased, but not in a statistically significant manner compared to the trend in *Control* ($p = 0.101$). Among the four treatment groups no significant difference in the average group contributions is found.[11] The right-hand panel in Fig. 1 shows the development of group contributions in Stage 1 and 2 over time.[12] In all treatment groups, the pledge led right at the outset to a change in contributions. Thereafter, the contributions in the sequential treatment groups deteriorated in a similar way to those in the *Control* group. The decay in *Simultaneous,* in contrast, was much steeper. We will come back to this when discussing the dynamic development of individual contributions. Among the treatment groups, the highest contribution level could be achieved in *SQ.Average*, in the first round immediately after the pledge, as well as in all subsequent rounds.

In sum, we find that the pledging possibility leads to higher group

[11] Comparison between *Simultaneous* and *SQ.Average:* p = 0.117.

[12] All treatment groups started, on average, at the same contribution levels in Stage 1, the baseline stage. Over the course of interaction, group specific effects developed and different trajectories emerged. To account for these, we control in the regression models for the experiences a player made in Stage 1.

Table 4
Tobit panel regression on the contributions in stage 2.

	(1)	(2)	(3)
Variables	Contributions in Stage 2		
Simultaneous	9.477***	20.362***	6.762**
	(2.632)	(3.064)	(3.392)
SQ.Random	11.274***	17.136***	3.848
	(2.709)	(3.107)	(3.409)
SQ.Endog	8.479**	12.537***	−0.259
	(3.636)	(3.949)	(4.077)
SQ.Average	18.243***	23.964***	6.361*
	(2.728)	(3.206)	(3.800)
Round	−1.928***	−1.098***	−1.095***
	(0.087)	(0.152)	(0.152)
Simultaneous × Round		−1.875***	−1.871***
		(0.251)	(0.251)
SQ.Random × Round		−1.039***	−1.050***
		(0.248)	(0.248)
SQ.Endog × Round		−0.742***	−0.734***
		(0.243)	(0.243)
SQ.Average × Round		−1.001***	−1.007***
		(0.261)	(0.261)
N° Pledge Others			7.330***
			(1.007)
Contrib_Avg1	2.885***	2.913***	2.739***
	(0.262)	(0.265)	(0.248)
Others Contrib_Avg1	−0.610***	−0.617***	−0.578***
	(0.097)	(0.099)	(0.092)
Constant	11.169***	6.502**	7.180**
	(2.951)	(3.074)	(2.881)
Observations	4800	4800	4800
Number of subjects	480	480	480

Notes: This table presents the results of random effect tobit models on the contribution levels in Stage 2. The contribution behavior in the Control group serves as reference. The 'Round' variable accounts for the round iteration in which the contribution was made. 'N° Pledge-makers' accounts for the amount of Pledge-makers in one's matching group. 'N° Pledge Others' accounts for the number of other Pledge-makers. A subject's previous average contribution behavior is taken into consideration with 'Contrib_Avg1′. 'Otherscontrib_Avg1′ accounts for the average contribution level a subject experienced through others in the baseline stage. All models include experimenter fixed effects. Robust standard errors, clustered on the group level, are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

contributions to the public good. However, we do not find that any of the sequential elicitation mechanisms additionally increased group contributions compared with the simultaneous setting. As seen in the previous section on pledge-making, groups differed greatly in their composition and amount of pledge-makers. In the following, we thus base the analysis on individual contributions and control for group specific compositions and dynamics.

5.2.1. *Effect of the pledge on first contribution decision (without group interaction)*

At first, the pure pledging effect on individual contribution behavior is analyzed. Thus, we begin the analysis by examining the effect of the pledge on contributions made in the first round, in which no prior interaction had taken place. When Stage 2 started, new groups were formed so that subjects could not make predictions, based on previous behavior, as to how new group members would behave. The pledges were the only available indication of how other group members intended to contribute.

Table 5
Behavior of low contributors.

	(1)	(2)
Variables	Pledge-making *Low Contributors*	Difference in Contributions *Low Contributors*
Simultaneous		−0.220
		(1.267)
SQ.Random		0.408
		(1.597)
SQ.Endog		−0.962
		(1.587)
SQ.Average		0.288
		(1.324)
Simultaneous × Pledge-maker		6.614***
		(1.568)
SQ.Random × Pledge-maker	0.052	7.627***
	(0.102)	(1.600)
SQ.Endog × Pledge-maker	0.030	7.792***
	(0.148)	(1.417)
SQ.Average × Pledge-maker	0.254**	8.746***
	(0.113)	(1.384)
Contrib_Avg1	0.016	
	(0.014)	
Otherscontrib_Avg1	−0.006	−0.161***
	(0.004)	(0.032)
Constant		4.723***
		(1.156)
Observations	200	2520
ID		252

Note: Pledge-making: Column (1) presents the marginal effects of a probit regression on the likelihood that a subject who classified as 'Low contributor' (i.e. contributed less than 11.03 Taler) made the pledge. The pledging behavior in the Simultaneous treatment serves as reference. Contributions: Column (2) presents the results of a Random Effects GLS Regression on the difference between Stage 2 and Stage 1 contributions for Low contributors. The change in contributions of Low contributors in the control group serves as reference. All models consider individual controls, such as gender, age and whether the subject studied Economics or Business. Robust standard errors are shown in parentheses. In column (2) standard errors are clustered on the group level. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

Table 3 presents the results of a censored Tobit model estimating the contribution levels in the first round of Stage 2. The variables 'Contrib_Avg1' (average contribution levels of individuals before the pledge) and 'Otherscontrib_Avg1' (average contribution levels of other group members contributed in Stage 1) control for heterogeneities with which subjects may have entered the second stage.[13][14] Model 1 measures the overall treatment effects. As seen in Fig. 1, having a pledging option available led, in all treatment groups, to higher contribution levels beyond the usual restart effect,[15] compared with contributions in the control group ($p < 0.001$). Between treatment groups, however, contributions in this first contribution round were similar. Model 2 estimates separately the contributions for individuals who made the pledge and those who decided against it. Pledge-makers are clearly the source

[13] An example of these heterogeneities is the significantly lower contribution levels in *SQ.Random,* caused by one session in which subjects contributed very low amounts in the baseline. We decided to leave this session in to show the results on basis of the complete dataset. However, when performing the analysis without this session, the results do not change. Please note, the changes in *SQ.Random* do not constitute the main results, but serve as a control comparison with the behavioral changes in *SQ.Average* and *SQ.Endog*. Table AIII in the appendix shows the average contributions for all treatment groups and stages.

[14] For a robustness check, we have performed the same analysis using the change in contributions between the first rounds in Stage 2 and Stage 1 as dependent variables. The findings did not change.

[15] The restart effect describes that contributions increase simply because participants were told that something new starts (Chaudhuri, 2018).

of the observed increase in contributions. In all treatment groups, contributions of pledge-makers were significantly higher than contributions of individuals who decided against the pledge ($p < 0.001$). In addition, pledge-makers in *Simultaneous* increased their contributions significantly more than pledge-makers in the other treatment groups ($p < 0.001$). This is in line with the findings of earlier studies; the commitment to promised behavior is stronger when individuals decide autonomously to make the promise (Charness & Dufwenberg, 2010).

Models 3 and 4 examine the conditionality of the pledging effect: Both models include the number of (other) pledge-makers in one's matching group as an explanatory variable. To facilitate readability, we present only the simplified model in which the difference between the pledging treatment groups is not distinguished. However, the patterns in the treatment groups are similar. Table A4 in the appendix shows the corresponding regression model and Fig. A2 illustrates graphically the increase in contribution, based on the number of pledge-makers in one's group and the corresponding treatment group. Contributions are higher the more group members made the pledge and the highest contribution levels were reached in groups in which all members made the pledge. This result is consistent with the literature (Koessler et al., 2021; Orbell et al., 1990); the more group members comply with the pledging request, the more salient is the new behavioral standard or as Bicchieri interprets the same result in Orbell et al. (1990): *"Individuals are more likely to cooperate when everyone in the group promises to cooperate, that is, when a consensus on how to behave is reached and an informal social contract is established."* (Bicchieri, 2006). A complementary analysis offered in Table A4 shows this consensus is reflected in altered first order beliefs; the more pledge-makers are present in one's group, the higher the expectations about the other group members' future contributions, what, in turn, reinsures the pledge-maker's intention. This provides support for Prediction 1.

Result 5: The greater the number of group members who have made the pledge, the stronger the positive influence of the pledge on contributions. The highest contribution levels were reached when all group members made the pledge.

Model 4 examines the effect of social influence on pledge-makers and subjects who decided against the pledge separately. For the latter, the change in contributions was dependent on the actions of the majority of other players. When a critical mass of pledge-makers (2 or all of the other 3 group members) was present, non-pledge-makers contributed significantly more than subjects in the *Control* group, regardless of the fact that they previously decided against the pledge.[16] On the other hand, when individuals were pledge-makers, contributions always increased significantly after the pledge. The smallest increase in pledge-makers' contributions was found when the subject was the only pledge-maker in her matching group. Being in the company of a critical mass of other pledge-makers strengthens the pledging effect additionally ($p < 0.05$). It then made no statistically significant impact whether two additional or all group members made the pledge ($p = 0.865$). Knowing that the majority of others had also decided to make the pledge was sufficient to support an individual's intention and motivated, in accordance with Prediction 1, an increase in contributions.

Result 6: Subjects who decided against the pledge nonetheless increased their contributions when the majority of their group members made the pledge.

Result 7: Subjects who made the pledge increased their contributions significantly after the pledge. The presence of a majority of other pledge-makers (2 or more) amplified the contributions additionally.

Another way to analyze the effect of the pledge is to examine compliance with the pledged behavior. When a pledge-maker was the only group member to make the pledge, these single pledge-makers ($N = 12$) fulfilled their pledge and donated the socially optimal amount 83% of the time in the first contribution round. When other group members also made the pledge, the compliance rate increased[17] up to 99.1% when all group members made the pledge ($N = 108$). Thus, pledge compliance was also higher and group behavior consequently more uniform in this first contribution round when more group members made the pledge. Since this is when group members received for the first time feedback on the contribution behavior of their group members, this difference may have been an important anchor for the contribution dynamics groups developed in subsequent rounds.

5.2.2. *Effect of the pledge on contribution behavior evolving with repeated group interactions*

The previous analysis showed that subjects who made the pledge, contributed significantly more to the public good directly after the pledge than subjects in the control group. Moreover, subjects who decided against the pledge also contributed significantly more when there was a critical mass of pledge-makers in their group. But how persistent was this increase in contributions? Did the positive effect of the pledge collapse after a few interactions or could a long-lasting behavioral change be manifested? Table 4 shows results of random effects tobit models estimating the levels of individual contributions for all rounds and treatment groups in Stage 2. In Model 1, average total contributions are compared. The analysis reveals that contributions in all pledging treatment groups are significantly higher than in Control. In line with the previous results, the strongest positive impact of the pledging option is found in *SQ.Average*. Here, significantly more players made the pledge, with thus the salience of the new behavioral standard being stronger and inducing more extensive behavioral changes than under all other treatments. The comparison with contribution levels in the other treatment groups reveals clear significant differences ($p = 0.014$ and $p = 0.010$ for the comparison with *SQ.Random* and *SQ.Endog*, and $p = 0.002$ for the comparison with *Simultaneous,* respectively).

To examine the development of the treatment effect on contributions over time, round parameters are interacted with treatment dummies in Model 2. Now it becomes visible that, over time, contributions in all groups, control or treatment, deteriorated significantly. Introducing the pledging possibility did not attenuate the decrease commonly observed in repeated public good games (Isaac, McCue & Plott, 1985). In fact, the decline in the treatment groups is even stronger than in the control group. Particularly in *Simultaneous,* the decay is steep and significantly stronger than in the other treatment groups ($p < 0.01$).[18] This effect is robust and remains when we control for the amount of pledge-makers in one's matching group, as done in Model 3. This stronger decline in contributions can be attributed to the lower proportion of pledge-makers in the *Simultaneous* treatment condition. Here, the newly introduced behavioral standard was less adhered to by large parts of the groups. Consequently, pledge-makers reduced their contributions more rapidly when they realized that they were in the minority, regardless of the pledge they made or their initial interest in coordinating on better outcomes. This finding provides additional support for Prediction 1.

Result 8: When there were more pledge-makers in a matching group, the increase in contributions prompted by the pledge was sustained for longer.

In sum, pledge-making raises contributions to a higher level at the outset, with no significant difference being detected in the increase between the different pledging schemes. However, once group members begin to interact, individual contributions are more likely to remain high, the more uniformly groups chose to pledge, which was most often the case in the *SQ.Average* treatment group. Complementary support for

[16] H0: N° *pledge others* $= 1 = N^{\circ}$ *pledge others* $= 2$: $F_{1,469} = 3.24$, $p = 0.072$, H0: N° *pledge others* $= 1 = N^{\circ}$ *pledge others* $= 3$: $F_{1,469} = 6.26$, $p = 0.013$.

[17] 91.1% when one other group member made the pledge; 97.3 % when two other group members made the pledge.

[18] H0: *Simultaneous* × Round = *SQ.Random* × Round: $\chi 2 = 9.02$, $p = 0.003$, H0: *Simultaneous* × Round = *SQ.Endog* × Round: $\chi 2 = 16.94$, $p < 0.001$, H0: *Simultaneous* × Round = *SQ.Average* × Round: $\chi 2 = 9.08$, $p = 0.003$.

this provides a group-specific compliance analysis. In groups in which all group members made the pledge (27 groups across all treatments), 78% reached the social optimum – and thus met the pledge – in more than 50% of the rounds. 60% even met the social optimum in all but one, usually the last, round. For groups with lower proportion of pledge-takers, the social optimum is not reached at all or only in a small number of rounds in Stage 2.

5.2.3. *Behavior of low contributors in the pledging treatments*

One key question was whether subjects who are not socially oriented (i) can be nudged to pledge socially-optimal behavior, motivated by observing the majority in doing so, and (ii) whether this commitment would be strong enough to motivate a behavioral change in these subjects. To examine these questions, we identify subjects who contributed less than average in the baseline stage (mean contribution from Stage 1 < 11.03) as low contributors, and test whether they behave differently before and after the pledge. Table 5 shows the regression results estimating (i) the likelihood of a pledge and (ii) the difference in contribution behavior for those low contributors.

Model (1) indicates that low contributors were particularly susceptible to the pledge in the *SQ.Average* treatment group. The exposure to a majority of pledge-makers was obviously effective. Low contributors were 25 percentage points more likely to make the pledge in *SQ.Average* than, for example, in the *Simultaneous* setting ($p = 0.025$). Model (2) estimates the average difference in contributions between Stage 1 and Stage 2 rounds. Low contributors, who have been motivated to make the pledge, increased indeed their contributions in a statistically significant manner ($p < 0.001$).

Result 9: Subjects who previously acted in a non-social way and chose to make a pledge, significantly increased their contributions after the pledge.

To probe for the robustness of this finding, we examine the changes in contributions based on the decision order in *SQ.Average*. Fig. A3 in the appendix shows how much respective group members increased their contributions. The finding is confirmed; group members who were asked last about the pledge, i.e. the former low-contributing subjects, increased their contributions significantly.

6. Conclusion and discussion

In this paper, we have examined how social information influences the motivation of individuals to publicly commit to act socially-optimal in the future. We elicited pledges sequentially (1) by a random mechanism, (2) by a self-determined elicitation order, or (3) based on previously-exhibited social behavior. In doing so, we controlled for the role of social influence in the pledging decision. Subsequently, we examined whether decision-makers can be nudged to make a pledge when information about the decisions of their peers is available, and if so, whether a pledge motivated by social influence is effective in stimulating socially-beneficial behavior.

Subjects who made the pledge in this study increased their contributions in the subsequent rounds regardless of how the pledge was elicited, that is, in which treatment the individuals made the pledge. What made a difference was whether other persons in their group also decided to make the pledge. If so, this increased contributions further. By determining the elicitation order based on previous contribution behavior, we have identified a way in which to increase the likelihood of positive announcement among *first movers*. Under this scheme, subjects who had previously contributed more than average were the first to be asked whether they wanted to pledge. This allowed a majority of pledge-makers to be established, before it was the turn of the previous low contributors to make a decision about the pledge. Since they were then facing a critical mass of pledge-makers, a desire to conform was stimulated. Consequently, many of the previous low contributors also pledged and, interestingly, also changed their behavior after the non-binding pledge. The highest contribution levels were reached when all players made the pledge. In the treatment group, in which no decision order was determined, pledging decisions were more heterogeneous than when previous high-contributors were targeted to make the first decision.

Even though our findings come from a laboratory experiment and their external validity is limited, in our opinion, some lessons can be drawn for application in practice. First, it is not only the inherent social orientation of an actor that determines the decision whether or not to make a pledge, but also which behavior the decision-maker observes in her peers. Thus, providing information about the pledging decisions of others can be a 'nudge' that not only motivates actors (who are not socially-oriented) to pledge, but which can also initiate a later change in behavior. Second, when doing so, special attention should be paid to from whom the first pledges are elicited if new behavioral standards in a social group shall be promoted. Social influence does not necessarily need to lead to more socially desirable outcomes, depending on the decisions of the first movers, it is also possible that groups conform to anti-social behavior. Therefore, when using pledges to motivate actors towards more socially desirable behavior, e.g. transitions to more climate friendly behavior or other practises which are at the individual level costly but benefit the collective, it is advisable to develop a protocol on which basis potential pledge-makers are approached and how the information about their pledging decision is made public. When this sequence is carefully constructed, the findings of this experiment suggest, pledges can be an effective cooperation booster.

For future research (at least) three questions remain open. First, what happens when actors can remain silent on their pledging decision? Research has shown that humans have a preference to respond positively to pro-social requests, yet, when given the option of avoiding being asked, a substantial percentage makes use of this possibility (Andreoni, Rao & Trachtman, 2011). Second, in our study, the main effect occurred immediately after the pledge, contributions increased, and the level effect remained in most treatment groups over the course of the ten interaction rounds. But it is unclear what happens when interactions are analyzed over a longer period of time. Does the pledging effect fade over time? Third, the pledge in our study mandated to realise socially optimal behavior, i.e. contributing the entire endowment in all rounds of the second stage – a distinct and potentially taxing request. An interesting investigation could be to examine how behavior changes when the pledge allows for more flexibility and does not specify an explicit target.

Overall, pledges remain an interesting voluntary approach to encourage pro-social behavior without being a deterrent.

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Appendix

Table A1 shows how in *SQ.Endog* individuals with higher average contributions in Stage 1 were more willing to make the pledge as first movers. This selection effect is exploited in *SQ.Average* and the elicitation order is exogenously determined based on the average contributions in Stage 1.

Figure A1 shows how often groups with a specific number of pledge-makers were observed in a treatment group. Each treatment group has a total of 24 groups. The numbers in each segment indicate how many of

Table A1
Average contributions in Stage 1 and consequent decision order.

Decision Order		Treatment Control	*Simultaneous*	*SQ.Random*	*SQ.Endog*	*SQ.Average*
All	1			9.76 (4.23)	12.72 (4.72)	17.20 (3.22)
	2		–	10.13 (5.10)	11.33 (4.73)	14.43 (3.76)
	3		–	8.88 (5.36)	9.61 (5.59)	10.89 (3.31)
	4		–	9.61 (6.41)	9.61 (3.87)	7.38 (4.13)
	Total	11.46 (5.22)	10.79 (4.70)	9.59 (5.27)	10.82 (4.87)	12.48 (5.15)
Pledge-makers	1			11 (4.33)	13.76 (4.47)	17.67 (3.26)
	2		–	10.13 (5.10)	11.67 (5.66)	15.45 (2.98)
	3		–	8.86 (5.36)	9.98 (6.10)	11.39 (3.25)
	4		–	9.61 (6.41)	9.64 (4.59)	7.82 (3.92)
	Total	11.46 (5.22)	12.13 (4.64)	10.82 (5.07)	11.51 (5.40)	13.24 (5.00)

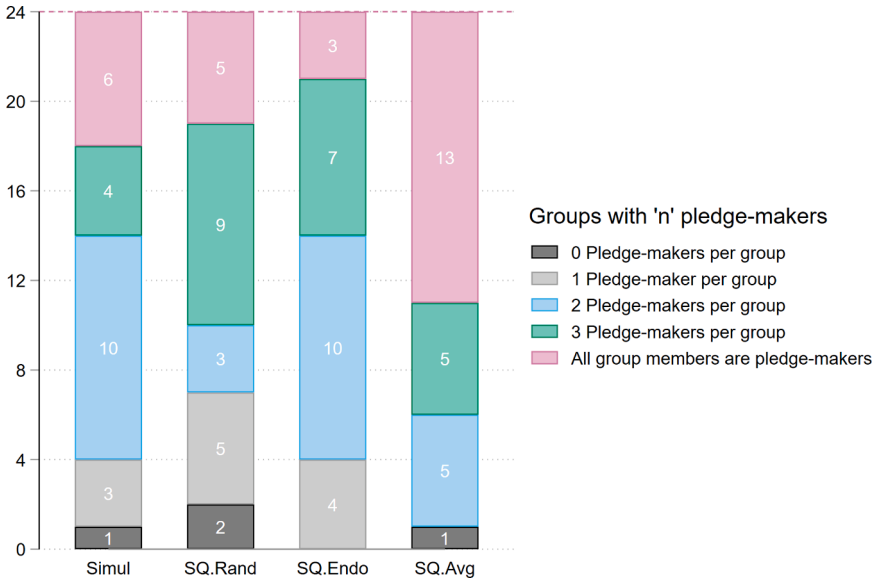

Fig. A1. Distribution of groups with a specific number of pledge-makers per group.

Table A2
Pledging likelihood by Decision order and the number of pre-existing Pledge-takers.

Decision Rank		T1: *Simul*	T2: *SQ.Random* N° of pre-exist. Pledge-takers					T3: *SQ.Endog* N° of pre-exist. Pledge-takers					T4: *SQ.Average* N° of pre-exist. Pledge-takers				
			Total	0	1	2	3	Total	0	1	2	3	Total	0	1	2	3
1	%	0.61	0.58	0.58	–	–	–	0.71	0.71	–	–	–	0.83	0.83	–	–	–
	N			24	–	–	–		24	–	–	–		24	–	–	–
2	%		0.63	0.40	0.79	–	–	0.67	0.71	0.65	–	–	0.8	0.75	0.85	–	–
	N			10	14	–	–		7	17	–	–		4	20	–	–
3	%		0.63	0.17	0.86	0.73	–	0.50	1	0.36	0.55	–	0.79	0	0.67	0.88	–
	N			6	7	11	–		2	11	11	–		1	6	17	–
4	%		0.58	0.60	0	0.67	0.63	0.50	–	0.56	0.44	0.50	0.75	0	1	0.50	0.87
	N			5	2	9	8		0	9	9	6		1	2	6	15
Total	%	0.61			0.60					0.59					0.80		
		96			96					96					96		

Note: This table shows the likelihood that a player made the pledge, depending on the position in the decision order (vertical) and the number of pre-existing Pledge-makers (horizontal). The rows in italic show the number of observation for each case.

Table A3
Total observation per treatment.
Average contributions per stage and treatment.

Treatment	Stage 1 Mean contributions	Stage 2 Mean contributions	Pledge-takers
Control	11.46 (6.85)	10.89 (7.56)	0.00%
Simultaneous	10.79 (6.95)	13.13 (8.56)	61.46%
SQ.Random	9.59 (7.40)*	12.97 (8.59)	60.42%
SQ.Endog	10.82 (7.20)	13.80 (8.23)	59.38%
SQ.Average	12.47 (6.70)	15.66 (7.15)	80.21%

* Total observations per treatment were 96. Standard deciations are shown in parentheses. Please note, despite the random allocation of sessions in treatments, average contributions were not identical in the baseline stage. In *SQ.Random*, average Stage 1 contributions were significantly lower than in the other treatment groups. This difference is caused by one session in which subjects contributed very low amounts in the baseline stage. We decided to leave this session in to show the results based on the complete dataset. Robustness checks, however, have been performed without the session and results do not change. Please also note that this difference in the baseline potentially curtails, but not magnifies the effects we have found and discussed in the paper.

Table A4
Estimation of first order beliefs in 1st round after the pledge, considering all treatments and N° of (other) pledge-makers.

	(1)		(2)		
Simultaneous	3.997***	Subject decided not to make the pledge	**N° of Pledge-makers** in the matching group	*0*	−3.071***
	(0.787)				(0.689)
SQ.Random	3.728***			*1*	1.196
	(0.864)				(0.785)
SQ.Endog	3.576***			*2*	4.175***
	(0.984)				(0.577)
SQ.Average	4.754***			*3*	6.556***
	(0.754)				(0.746)
		Subject decided to make the pledge (**Pledge-maker**)	**N° of other Pledge-makers in** the matching group	*0*	−3.529***
					(1.337)
				1	1.107
					(0.679)
				2	4.269***
					(0.563)
				3	7.476***
					(0.518)
Contrib_Avg1	0.285***				0.214***
	(0.067)				(0.050)
Otherscontrib_Avg1	0.032				0.044***
	(0.023)				(0.017)
Constant	7.712***				8.116***
	(0.675)				(0.631)
Observations	480				480
R-squared	0.264				0.591

Note: This table presents the results of OLS models estimating subjects' beliefs about the average contribution of the other players in the first round of Stage 2. 'N° Pledge others' accounts for the number of (other) Pledge-makers in one's group. The interaction with 'Pledge-maker' estimates the effect size separately for individuals who decided to pledge. All models include experimenter fixed effects. Robust standard errors, clustered on the group level, are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

the 24 participating groups had the respective number of pledge-makers.

Table A2 shows the likelihood that a player made a pledge, depending on the treatment group, the position in the elicitation order, and the information that was available about the pledging choices of previous players. For example, a player who made in *SQ.Average* as the second player the decision about the pledge, was 75% likely to make the pledge when the player before her decided against the pledge. When the previous player, however, made the pledge, then the second player also made the pledge with a likelihood of 85%.

Three observations can be made from Table A3. First, the likelihood of observing a pledge increases with the number of pledge-makers who previously made the pledge. Second, the proportion of pledge-makers at the outset (first row, decision order = 1) differs among the treatment groups and this difference amplifies from one row to the next. Third, comparing the cases when the amount of predominant previous pledge-makers and the position in the decision order match, the likelihood that a player makes the pledge is lower in *SQ.Endog* than in the other two treatment groups.

Fig. A2 shows how the increase in Round 1 contributions between Stage 1 and 2 differs between treatment groups and the number of present pledge-takers in one's group. The overall increase in contributions was stronger the more pledge-takers were present in one's matching group. This pattern is found in all treatment groups. The effect size in these subgroups partly differs between treatment groups, but also observation numbers for each box chart are very low. In total, each treatment consisted of 24 matching groups.

Table A5
Estimation of the 1st round contribution considering all treatments and N° of (other) pledge-makers.

Subject decided not to make the pledge	**N° of Pledge-makers** in matching group	***0***	*Simultaneous*	0.983	*SQ. Random*	−0.460	*SQ. Endog*	*na*	*SQ. Average*	−4.233***
				(1.169)		(1.269)				(0.857)
		1		0.452		−1.396		0.056		*na*
				(1.581)		(1.342)		(2.275)		
		2		2.684*		−0.253		2.809		1.169
				(1.447)		(5.724)		(2.108)		(3.578)
		3		6.956*		4.084		6.216*		0.551
				(3.626)		(3.726)		(3.260)		(2.328)
*Subject decided to make the pledge (**Pledge-maker**)*	**N° of other Pledge-makers** in matching group	***0***	*Simultaneous*	55.172***	*SQ. Random*	14.169***	*SQ. Endog*	13.435***	*SQ. Average*	*na*
				(4.535)		(4.452)		(4.178)		
		1		56.555***		8.565***		22.165***		12.179**
				(4.140)		(2.646)		(6.443)		(5.344)
		2		61.971***		26.269***		21.736***		60.248***
				(4.573)		(3.265)		(6.526)		(4.278)
		3		59.847***		58.562***		16.857***		58.988***
				(4.331)		(4.314)		(4.976)		(4.324)
	Contrib_Avg1					1.664***				
						(0.189)				
	Otherscontrib_Avg1					−0.211***				
						(0.064)				
	Constant					0.534				
						(1.629)				
Observations						480				

Notes: This table presents the results of a tobit model, censored on the lower (0) and upper bound (20), estimating the contributions in the first round of Stage 2, after the pledging decision was made. The variables *Simultaneous, SQ.Random, SQ.Endog* and *SQ.Average* are dummy variables that take the value one in the corresponding treatments, and zero otherwise. 'N° pledge-makers' accounts for the amount of pledge-makers in one's matching group. 'N° pledge others' accounts for the number of other pledge-makers. The interaction with 'Pledge-maker' (first column) estimates the change in contributions for individuals who have decided to pledge. All models include experimenter fixed effects. Robust standard errors, clustered on the group level, are shown in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

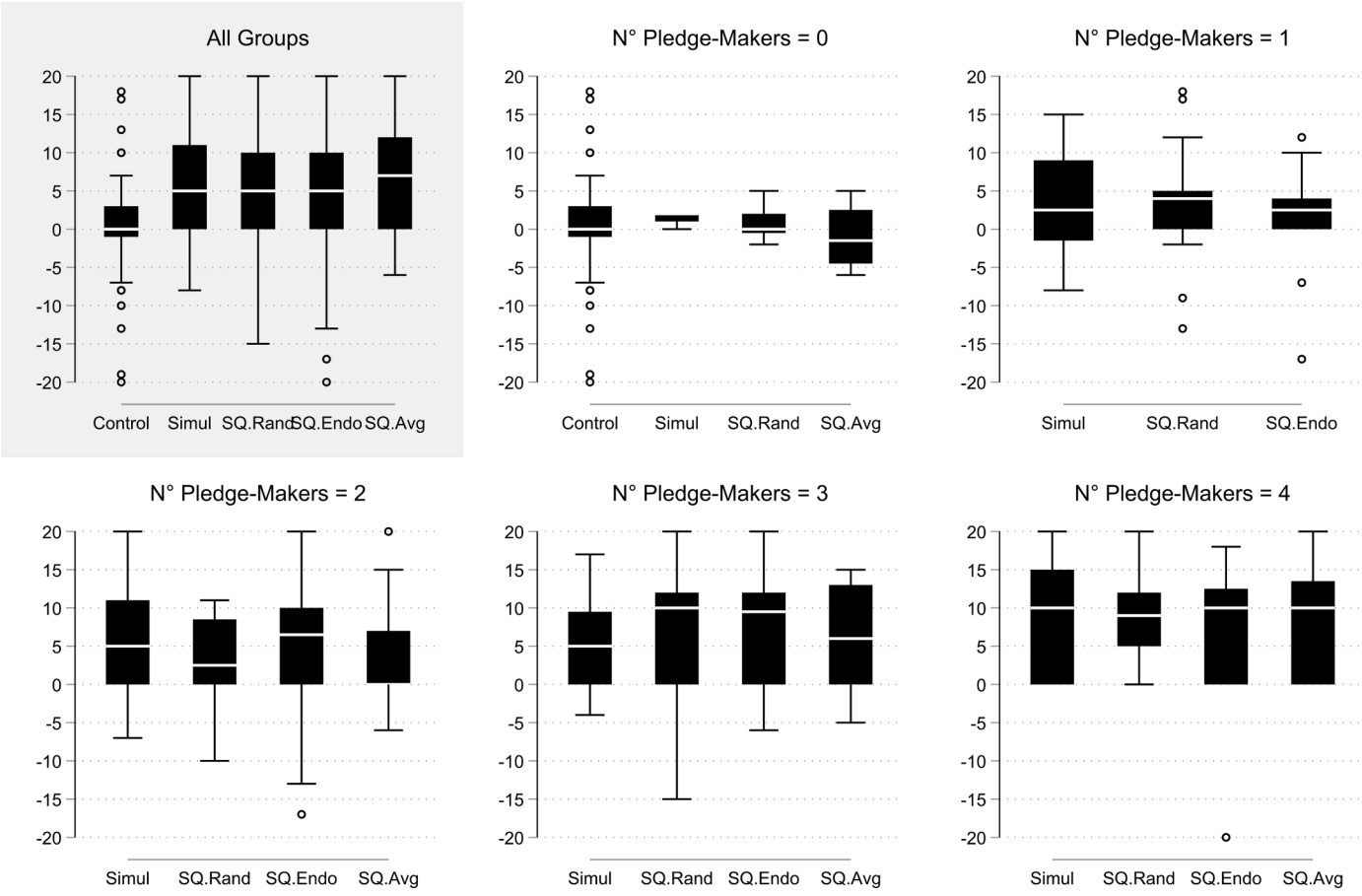

Fig. A2. Increase in Round 1 contributions from Stage 1 to Stage 2.

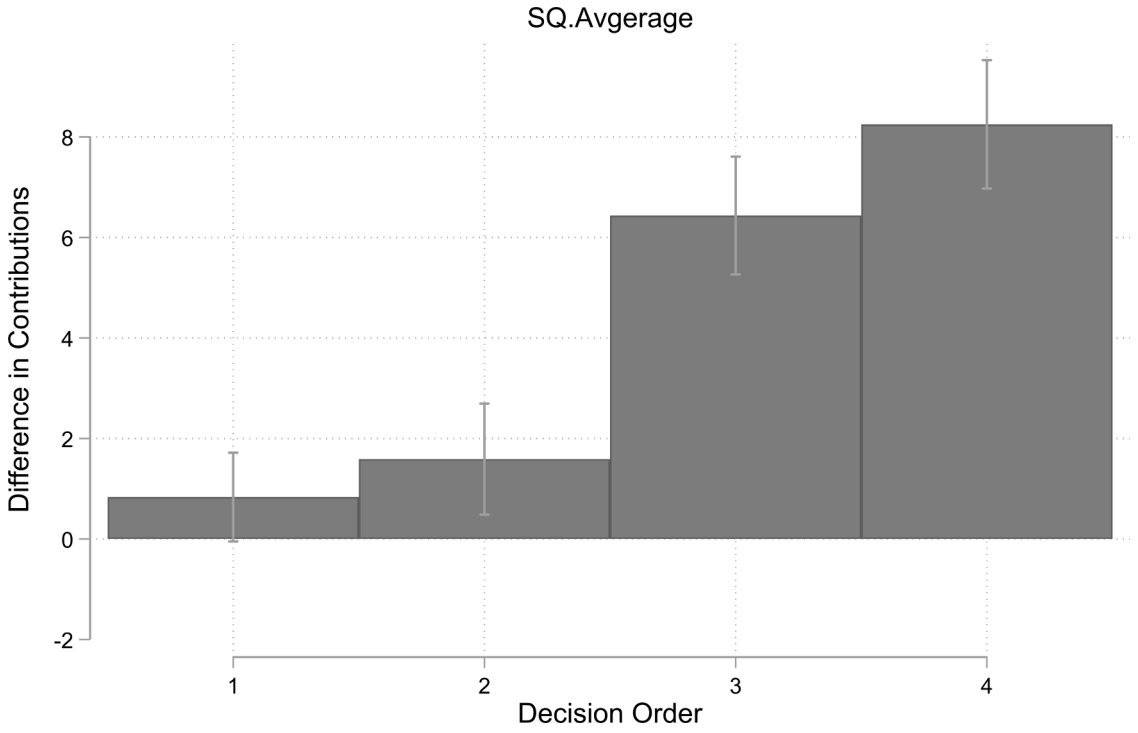

Fig. A3. *SQ.Average* - Average change in contributions of pledge-makers by decision order.

Fig. A3 shows the average difference in contributions before and after the pledge of pledge-makers in *SQ.Average*. The graph displays the difference for each position in the order in which subjects were asked whether they wanted to make the pledge. By treatment design, subjects with higher baseline contributions were asked first. The observation in the main text is confirmed; low contributors, who were asked later in time about the pledge, increased their contributions significantly more than subjects who were the first to be asked about the pledge (Wilcoxon rank sum test of $1 + 2$ vs. $3 + 4$: $z = 4.062$, $p < 0.001$).

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