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Session size and its effect on identity building:
Evidence from a public goods experiment

Qian Weng*

Abstract

The effect of session size has largely been ignored in experimental studies, despite the possibility that it may play a role by changing people's perception of the potential chance of encountering a certain type of people and by affecting the strength of the potential link between people. This paper investigates how the effect of an induced common identity on individual cooperative behavior differs depending on session size in a repeated public goods experiment with constant group size and partner matching. We find that induced identity significantly enhances cooperation only when the session size is small and only in the initial period. In all other periods, the effect of induced identity on cooperation is the same in small and large sessions, suggesting that session size is not a confounding factor of identity in repeated interaction settings.

Keywords: session size; identity building; public goods experiment; China
JEL Classification: C91; D71; H41

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1. Introduction

According to social identity theory (Tajfel and Turner, 1979; 1985), social identity describes the aspects of an individual's self-concept derived from perceived membership in social groups. Once a person identifies herself as part of a group, her attitudes, values, and norms may be shaped by the group, and her behavior hence conforms to the stereotypes associated with the group's identity. Before it was systematically introduced into economic analysis by Akerlof and Kranton (2000), identity had already been recognized as a central concept to understand phenomena in social psychology, sociology, anthropology, and political science. Economic experiments studying the effects of identity on human decision making employ three design methods, i.e., using natural identities within existing social groups (e.g., Bernhard et al., 2006; Goette et al., 2006; Goette et al., 2012), priming natural social identities (e.g., Afridi et al., 2012; Benjamin et al., 2010; Chen et al., 2010), and inducing artificial group identities. A number of economic experiments using induced identities have shown that individual behavior is affected by group identity, and the extent of the effect depends on the salience of identity.[1] However, to our best knowledge, no previous study has considered the potential interaction between induced identity and the number of subjects in an experimental session, i.e., session size, which may also affect the salience of identity. In this paper, we use a laboratory experiment to investigate whether session size influences the effect of induced identity on individual cooperative behavior.

Broadly speaking, there are two common approaches to building and enhancing group identity in the existing experimental economics literature. One adapts the "minimal group paradigm" from social psychology to distinguish the identity between ingroup (with whom people identify) and outgroup (with whom people do not identify) members. Typically, two distinct group identities are first induced by randomly assigning all subjects in an experimental session to two non-overlapping groups based on some trivial tasks such as stating preferences for artwork by two different artists (e.g., Chen and Li, 2009; Chakravarty and Fonseca, 2010) or no task at all (e.g., Chen and Chen, 2011; Morita and Servátka, 2011). Group identities are then enhanced within each identity group by various means.[2] After identities have been induced (and enhanced), a game, e.g., a public goods game, prisoner's dilemma game, or trust game, is played, where a pair or group of subjects from the ingroup and/or

[1] A variety of games have been played to study the effect of induced identity on different individual behavior. See, e.g., Eckel and Grossman (2005), Charness et al. (2007), Smith (2011), Chakravarty and Fonseca (2010) on cooperation; McLeish and Oxoby (2007) on cooperation and punishment; Chen and Chen (2011) on coordination; Hargreaves Heap and Zizzo (2009) on trust; Chen and Li (2009) on social preferences; Sutter (2009) on individual and team decision making; Eberlein and Walkowitz (2008) on promotion; Morita and Servátka (2011) on relation-specific investment; and Riener and Schacht (2011) on a market setting.

[2] Identity-strengthening activities include completion of a group task with own identity group members through either face-to-face communication (e.g., McLeish and Oxoby, 2007; Smith, 2011) or online chatting (e.g., Chen and Li, 2009; Chakravarty and Fonseca, 2010; Chen and Chen, 2011), presence of own group members as audience when an individual makes the decision, or payoff sharing among group members (e.g., Charness et al., 2007).

outgroup interact. The number of subjects in a game-playing pair or group is generally smaller than the number of subjects with the same group identity, and the pairs or groups are often re-matched across periods in multiple period games. A general finding from the experiments using this approach is ingroup favoritism and outgroup discrimination when the group identity is salient.

However, in this approach, the number of subjects in a session is usually not controlled. The number can vary across experiments or across sessions in the same experiment depending partly on the number of people who showed up. No matter how the two identity groups are partitioned, the difference in the total number of subjects in a session and consequently the number of subjects in each identity group may affect people's perception of the ingroup/outgroup and the potential interactions that will occur. Increasing the number of subjects in each identity group tends to reduce the strength of group identity by making subjects feel less connected to the ingroup, and it is also likely that the perceived chance of encountering a certain type of subjects (i.e., selfish, altruistic, reciprocal, etc.) becomes slimmer.

The other identity-building approach forms a group membership without introducing an identity contrast or in fact even without the existence of an outgroup. The main difference from the previous approach is that group identity is built and enhanced only among the subjects (e.g., 3 to 5 people) who are randomly assigned to a group and will later interact in different games. Group composition always remains fixed throughout the experiment. Studies using this method of group identity building show that a salient group membership strongly affects individual behavior in both strategic (e.g., Eckel and Grossman, 2005) and non-strategic (e.g., Sutter, 2009) decision-making situations. Session size, however, may not matter much in this approach, since the same small fixed group of people share a common identity and play the games.

The aim of the present paper is to examine how session size may influence the effect of induced identity on individual cooperative behavior. We conduct a repeated-play linear public goods experiment, prior to which we manufacture the strength of identity between strong and weak depending on whether subjects participate in an identity-building activity or not, and vary the session size between small and large (with 8 and 24 subjects, respectively). Our identity-building activity combines the features of the above-described two approaches: all participants in one session play a face-to-face "human knot" game to induce one common identity, and then they are randomly assigned to fixed groups of four to interact in the public goods game. [3] Our activity hence adopts the merit of the second identity-building approach where no outgroup is needed for creation of identity conflict,[4]

[3] Eight is used as the small session size because it is the minimum number of participants that allows for anonymous and random group assignment to fixed groups of four subjects. Twenty-four is chosen as the large session size given that the capacity of the laboratory where the experiment took place is 25. These two numbers also represent the lower and upper bounds of session size in many of the public goods experiments that we are aware of.

[4] Chen and Li (2009) investigate the extent to which the presence of an outgroup affects behavior and find no significant difference from no outgroup.

and furthermore controls for the potential interactive effect of session size on identity. The same identity-building activity is used by Weng and Carlsson (2013), who study how induced identity together with endowment distribution and peer punishment interactively affects individual cooperative behavior.

Given the design of our identity-building activity, we expect session size to matter for the impact of identity on cooperation. Increasing the number of participants in the "human knot" game from 8 to 24 tends to reduce the proportion of participants one can meaningfully interact with over a given time duration, thereby increasing the social distance among the participants, and weakening the strength of the common identity and its influence on cooperation. This is similar as the effect of own identity group size on the strength of group identity and consequently on cooperation. Some psychological experiments have studied the interactive effect of group size[5] and induced identity in social dilemmas, and have confirmed the existence of such an effect. For example, Brewer and Kramer (1986) find that in a small-group public goods game (i.e., 8 people), individuals for whom a collective identity is made salient keep less for themselves compared to individuals with an individual-level identity, yet this outcome is reversed in a large-group condition (i.e., 32 people). De Cremer and Leonardelli (2003) on the other hand demonstrate that when social constraints that promote cooperation, such as accountability, personal identifiability and felt responsibility, are absent, members of small groups (i.e., 4 people) are more likely to contribute to a public good than members of large groups (i.e., 8 people) when the psychological need to belong to a group[6] is low, whereas the opposite is true when need to belong is high.

A related series of experiments have tested the direct effects of group size on public goods provision. A well-grounded conjecture is that a group's ability to provide the optimal level of a public good is inversely correlated with group size (e.g., Olson, 1965; Buchanan, 1968). The basis for this conjecture is that increasing group size tends to diminish the marginal per capita return (MPCR) from a contribution to an "impure" public good to all consumers (Isaac and Walker, 1988), and to make people feel less efficacious (Kerr, 1989), less identifiable and differentiable (Hamburger et al., 1975), and less responsible for the pursuit of group welfare (Stroebe and Frey, 1982). The empirical test results of the inverse relationship between group size and cooperation depend on whether the influences of variation in the MPCR and of a pure change in the number of group members are separated. Isaac and Walker (1988) and Isaac et al. (1994) examine the efficiency of public goods provision in groups of size 4, 10, 40 and 100, and find that the above conjecture is supported in the smaller groups (i.e., 4 and 10 people) if increases in group size generate a smaller MPCR, whereas holding MPCR constant, mean percentage of contributions is greater in larger groups (i.e., 40 and 100

[5] Group size is equivalent to session size when there is only one group in a session.

[6] According to the authors, psychological need to belong to a group is reflected in people's desire to form and maintain social relationships with others. It is measured using a Need to Belong Scale (Leary et al., 2001), which includes 10 items rated on a 5-point scale with 1 indicating "not at all characteristic of me" and 5 indicating "extremely characteristic of me".

people) than in smaller groups when the MPCR is low, and there is no discernible difference when the MPCR is high. This paper hence also tries to see whether there is any pure effect of session size, as an analogue to group size, on public goods contributions, while keeping MPCR constant.

We find that induced identity significantly enhances cooperation only when session size is small and only in the initial period. In all other periods, the effect of induced identity on cooperation is the same in small and large sessions, suggesting that the role of session size may be dominated by other factors, such as group norm adherence. Hence, session size is not a confounding factor of identity in repeated interaction settings. The remainder of the paper is organized as follows. Section 2 describes the experimental design, section 3 presents the results and analysis, and section 4 concludes the paper.

2. Experimental design

The experiment uses a 2×2 design. One dimension is to vary session size with either 8 or 24 subjects to establish a small or large session. The other is to manufacture the strength of identity to be strong or weak by conducting an identity-building activity or not. This generates four different combinations of conditions, each of which is a treatment of the experiment as summarized in Table 1.

<Table 1 about here>

The experiment was conducted in two stages. The first was an identity-building stage, which was only implemented in the two treatments with strong identity, i.e., Small-Strong and Large-Strong. A "human knot" game was played with all subjects in one session in another room before they entered the laboratory. Subjects stood shoulder to shoulder, in a circle, facing each other. They were first asked to form a knot by lifting both hands and reaching across the circle to hold the hands of two other subjects who were not standing directly beside them, left hand to left hand and right hand to right hand. After ensuring that a knot had been constructed, subjects were then asked to untangle the knot to form one or a couple of circles without ever letting go of any hands. Anyone who let go of a hand was required to immediately grab the hand again. The game lasted for approximately ten minutes. The reason for choosing this specific activity was that it fits the goal of the exercise, and also that it is a typical activity undertaken in orientation and training programs in real-world organizations. Communication was allowed during the course of the game. The experimenters observed that the communication closely surrounded the game. After finishing the identity-building activity, the subjects were led to the laboratory. In the two treatments with weak identity, i.e., Small-Weak and Large-Weak, subjects entered the laboratory directly once all 8 or 24 of them had arrived, but they had the chance to meet each other while waiting for the experiment to start.

The second stage was a decision-making stage, which was conducted in the laboratory in all four treatments. Subjects were seated in partitioned computer terminals and were then given written instructions while the experimenter read the instructions aloud. They first individually solved a quiz consisting of 20 general knowledge questions. The quiz was used only to legitimize the receipt of the endowment (see, e.g., Hoffman and Spitzer, 1985; Gächter and Riedl, 2005), but the quiz performance

did not affect the endowment level in the public goods game that followed. Then four subjects out of the 8 or 24 in one session were randomly assigned to a group and played a public goods game framed as a team production problem for 10 periods.[7] The subjects knew that their groups consisted of themselves and three other individuals, whereas their identities were kept anonymous throughout the experiment.

At the beginning of each period, each subject was endowed with 50 experimental currency units (ECUs). They decided simultaneously and without communication how to allocate this endowment between individual work and team work (i.e., the public good). By freely choosing an amount to contribute to the team work, c_i, where $0 \leq c_i \leq 50$, the remaining endowment of $50 - c_i$ was automatically considered the allocation to the individual work. Each ECU a subject kept for individual work generated herself one ECU payoff, whereas the payoff from the team work was 50% of the group's total contribution. That is, the MPCR from a contribution to the public good was equal to 0.5. The period payoff for subject i was hence given by $\pi_i = (50 - c_i) + 0.5 \sum_{j=1}^{4} c_j$.

The payoff function, the duration of the experiment (10 periods), and the instructions were common knowledge to all participants in each treatment. Before the commencement of actual decision making, subjects were required to answer control questions to ensure that they understood the features of the game correctly. At the end of each period, subjects were informed of their group's total contribution, their own earnings, and the contributions of other group members in the current period. To prevent the possibility of individual reputation formation, we randomly assigned an identification number from 1 to 4 to uniquely identify each of the four subjects' actions in one group in a given period, and randomly shuffled these numbers across periods.

The experiment was conducted using z-Tree (Fischbacher, 2007) in the experimental laboratory at Beijing Normal University in May and June 2011. This university is located in the center of Beijing and has approximately 20,000 full-time students. The subjects were recruited via announcements on a bulletin board system (BBS) and bulletin boards in teaching and accommodation buildings at the university. Two sessions were conducted for each of the two treatments with large session size (six groups in each session), and six sessions for each of the two treatments with small session size (two groups in each session). All subjects were allowed to participate in only one session, and they did not know about any treatments other than the one in which they participated. To control for experimenter effect, all sessions were run by the same two individuals, who were unknown to the participants. To keep the outcome of the experiment anonymous, subjects were informed at the beginning that they would be paid confidentially and individually in another room so that they would leave the laboratory successively and would not meet and communicate with other subjects after the session was

[7] It is noteworthy that a partner matching design would estimate a lower bound of the effect of session size, if there were any: since in a stranger matching protocol, session size determines the likelihood and the number of times two subjects interact in the given number of periods of an experiment, session size could have a more pronounced impact on individual behavior.

completed. The final earnings from the experiment totaled the sum of the period payoffs at an exchange rate of 1 ECU to 0.1 Chinese Yuan (CNY) plus a show-up fee of 10 CNY. On average, the experiment lasted for approximately 63 minutes, including above-described stages and a post-experimental survey covering questions on demographics, academic background, past donation behavior and perception of group closeness, and the subjects earned 84.5 CNY[8] including the show-up fee.

3. Results and discussions

In total, we have observations from 192 subjects[9], 48 for each treatment. The impact of session size and identity on contributions over time can be identified in Figure 1. Average contributions start at similar levels in the Small-Weak, Large-Weak, and Large-Strong treatments, ranging from 45% to 48% of the total endowment. They follow each other closely in the first five periods, and then contributions in Large-Strong start exceeding those in the other two treatments until the ninth period. The Small-Strong treatment displays higher contributions during the entire course of the experiment except in the sixth period. Moreover, contributions in all treatments rise in the early periods and then decline, although the peaks appear at different points in time and the rates of change differ across treatments.

<Figure 1 about here>

Table 2 reports, in the left panel, the cumulative period average contributions across treatments and, in the right panel, *p*-values of the pair-wise treatment comparisons using Mann-Whitney U tests on the null hypotheses that average contributions are equal in two different treatments. The unit of observation is subject for period 1 and group average for the relevant cumulative periods.[10] As shown in the left panel, average contributions in the Small-Weak, Large-Weak, and Large-Strong treatments do not differ much in any entries, and they are all lower than the contributions in the Small-Strong treatment. The non-parametric test results in the right panel confirm the general pattern. We find that there exists no statistically significant difference in contributions between small and large sessions over the entire course of the experiment, regardless of the strength of identity (*p*-value > 0.1 for all entries of columns (5) and (6)). This corresponds to the finding from the group size literature of no pure group size effect when the MPCR is held constant. Strong identity significantly raises contributions in small sessions in the first period (*p*-value = 0.083 in the first entry of column (7)), whereas this effect fades from the second period onwards (*p*-value > 0.1 for the rest of the entries in

[8] The average exchange rate in May and June 2011 was 1 USD = 6.48 CNY. The average hourly wage for university students in Beijing at the time of the experiment was approximately 50 CNY.

[9] All subjects were Chinese citizens and university students, but with various academic majors.

[10] Since subjects in a group interact for the first time in period 1, the contribution from each subject is an independent decision in this period. From period 2 onwards, a subject's contribution decision may also be affected by her and other group members' behavior in the previous period(s). This history dependency makes individual contributions no longer independent. Therefore, group average contribution, which takes account of this dependency within a group and is still independent across groups, is the appropriate unit of observation.

column (7)). This could be because identity built on a small group of people has an impact on behavior when individuals meet initially, but this effect is increasingly dominated by other factors in repeated interactions, such as group norm adherence. However, identity fails to exert any effect in large sessions over the entire course of the experiment (*p*-value > 0.1 for all entries of column (8)). Our results suggest that the effect of induced identity is stronger in small than in large sessions, which is in line with the finding from the psychological experiments that the strength of identification and importance attached to membership in experimentally created groups are greater for small than for large groups (Simon and Brown, 1987; Simon and Pettigrew, 1990).

<Table 2 about here>

To control for subjects' individual cross-period contribution differences and the interaction of group members across periods, we employ a random effects generalized least squares (GLS) model with robust standard errors clustered at the group level to analyze the interplay between session size and identity again. Table 3 presents the regression results. We use the following independent variables: *Small* is a dummy variable taking the value of one if the observation comes from small sessions and zero otherwise; *Strong* is a dummy variable equal to one if the observation comes from the strong identity treatment and zero otherwise; and *Small*×*Strong* is their interaction term. Period dummies are also included to control for the time effects. In order to test whether strong identity significantly increases contribution levels in small sessions in the initial period as found in the non-parametric test, regression (2) introduces interaction terms between *Period 1*, *Small*, *Strong* and *Small*×*Strong.* The regression results are fully consistent with the non-parametric test results: average contributions over the entire course of the experiment are similar between any two session size and identity strength combinations (see column (1) coefficients on *Small*, *Strong*, and bottom panel (i)-(ii)); and contribution is significantly higher in small sessions when identity is strong than weak in the first period (see column (2) panel (iii)).

<Table 3 about here>

A concern may be raised that our results are driven by the possibility that identity is stronger in small than in large sessions in the two strong identity treatments because the "human knot" is easier to untangle with fewer participants. This is probably true. However, we believe that the effect of identity comes from the action of participating in the task *per se*, not from the success of accomplishing the task or the length of the interaction with the other participants. This is manifested by the insignificant difference (Mann-Whitney U test, *p-value* > 0.1) in the self-reported effect (on a scale from zero to ten) of the "human knot" game on enhancing group attachments from the post-experimental survey. Therefore, our finding on the interactive effect of session size and identity is not contaminated by the easiness of "human knot" untangling.

Our results hence convey an important message to the literature studying the effect of induced identity on individual behavior. In a repeated interaction setting the effect of induced identity on individual behavior does not differ depending on the number of people with whom a manufactured

identity is shared. Consequently, variation in experimental session size does not generally affect subjects' perception of group membership or their behavior. However, on the other hand, the effect of identity does vary between small and large number of people who share the identity in the initial interaction, which implies that session size should be controlled in one-shot interactions.

It is also worth noting that our results lend support to a general finding in the induced identity literature that the extent to which induced identity affects individual behavior depends on the salience of identity (see, e.g., Eckel and Grossman, 2005; Charness et al., 2007). Our finding that identity does not significantly affect individual cooperative behavior, regardless of experimental session size, except in the first period in small sessions may be explained by the relatively low strength of identity even in our strong identity treatments. This low strength may result from our identity-building activity which is different from those commonly used in the literature. We induce one common identity in all subjects in one session without the existence of an outgroup, and subjects are then randomly assigned to fixed groups for repeated interactions. Neither introducing and enhancing an identity contrast as in the first identity-building approach nor forming a salient group membership with only the people who will later interact in various types of games as in the second approach undermines the strength of the identity built in our experiment to exert a significant effect.

4. Conclusions

In previous studies on the impacts of group identity where the identity has been induced in all subjects in an experimental session, the effect of session size has largely been ignored. Since interactions often take place between/among some of the subjects, variations in the total number of subjects may affect their perception of the extent of the interactions and consequently the results of the interactions. The present paper investigates how the effect of induced identity on individual cooperative behavior differs depending on session size in a repeated public goods experiment. We find that induced identity significantly enhances cooperation only when session size is small and only in the initial period. That the difference in the effect of identity in small and large sessions disappears already in the second period suggests that the role of session size may become dominated by other factors, and that session size does not confound the effect of identity in repeated interaction settings.

Our study attempts to raise attention to controlling session size in laboratory experiments which involve activities conducted with all subjects in a session. The activities include not only identity building but also others that could affect people's perception in a similar manner. A natural extension is to use another identity-building activity or method to test the robustness of our findings. It would also be interesting to consider a broader range of session size variations in different games to identify the potential thresholds to behavioral differences.

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Table 1. Summary of the experimental design

Treatments	Session size	Identity	No. of sessions	No. of participants
Small-Weak	8	Weak	6	48
Large-Weak	24	Weak	2	48
Small-Strong	8	Strong	6	48
Large-Strong	24	Strong	2	48

Notes: "Small-Weak" refers to the small session/weak identity treatment; "Large-Weak" refers to the large session/weak identity treatment; "Small-Strong" refers to the small session/strong identity treatment; "Large-Strong" refers to the large session/strong identity treatment.

Table 2. Cumulative period average contributions across treatments

Period	Treatment average contributions				*P*-values from Mann-Whitney U tests			
	Small-Weak	Large-Weak	Small-Strong	Large-Strong	Small-Weak = Large-Weak	Small-Strong = Large-Strong	Small-Weak = Small-Strong	Large-Weak = Large-Strong
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1	22.40	24.13	27.67	23.08	0.616	0.129	0.083	0.764
1-2	23.79	25.18	29.13	24.65	0.729	0.214	0.149	0.954
1-3	24.85	26.72	29.77	26.00	0.751	0.387	0.248	0.908
1-4	25.48	26.79	29.86	26.47	0.931	0.419	0.341	0.954
1-5	25.90	26.66	29.90	26.69	0.840	0.564	0.341	0.863
1-6	25.61	26.37	29.59	27.04	0.931	0.603	0.371	0.773
1-7	25.55	25.71	29.35	26.91	0.885	0.729	0.453	0.817
1-8	25.00	24.91	29.06	26.86	0.954	0.773	0.419	0.686
1-9	24.26	24.10	28.48	26.35	0.954	0.863	0.470	0.644
1-10	23.19	22.93	27.13	24.81	0.954	0.817	0.583	0.644

Notes: The left panel reports the cumulative period average contributions across treatments, starting from period 1 only, to first two periods, to all ten periods. The right panel reports the *p*-values of the pair-wise treatment comparisons using Mann-Whitney U tests. The unit of observation is subject for period 1 and group average for the relevant cumulative periods.

Table 3. Determinants of contributions

Dependent variable: contribution of subject *i* in period *t*, $c_{i,t}$		
	(1)	(2)
Small	0.265	0.486
	(4.339)	(4.677)
Strong	1.883	2.208
	(3.789)	(4.087)
Small×Strong	2.056	1.583
	(5.946)	(6.355)
Period 1×Small		-2.215
		(3.871)
Period 1×Strong		-3.250
		(3.688)
Period 1×Small×Strong		4.729
		(5.196)
Period 1	11.359***	12.910***
	(1.620)	(3.344)
Period 2	14.094***	14.094***
	(1.459)	(1.461)
Period 3	16.182***	16.182***
	(1.426)	(1.427)
Period 4	15.141***	15.141***
	(1.476)	(1.477)
Period 5	14.865***	14.865***
	(1.469)	(1.470)
Period 6	13.521***	13.521***
	(1.539)	(1.540)
Period 7	12.297***	12.297***
	(1.339)	(1.340)
Period 8	10.531***	10.531***
	(1.469)	(1.470)
Period 9	7.557***	7.557***
	(1.092)	(1.093)
Constant	11.370***	11.215***
	(3.264)	(3.458)
Observations	1920	1920
Wald Chi2	194.59***	204.13***
Linear combination of the model coefficients:		
(i) Small + Small×Strong	2.321	
	(4.065)	
(ii) Strong + Small×Strong	3.940	
	(4.582)	
(iii) Strong + Small×Strong + Period 1×Strong + Period 1×Small×Strong		5.271*
		(3.045)

Notes: Table reports the regression results for random effects GLS model with robust standard errors clustered at the group level in parentheses. The bottom panel shows the Wald test results of linear hypotheses about the model coefficients. Period 10 is used as the base period and omitted from the regression. *** indicates significance at the 1% level, * at the 10% level.

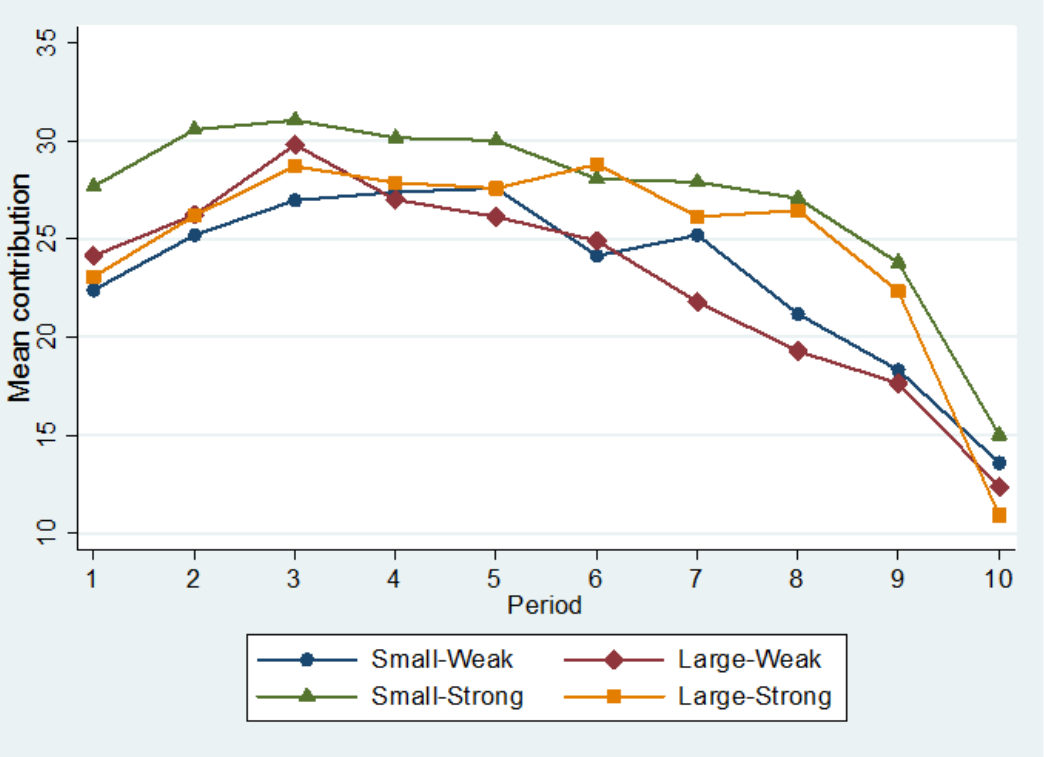

Figure 1. Evolution of average contributions across treatments