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Self-Regulatory Resources and Institutional Formation: A First Experimental Test*

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Abstract

This study conducts a novel laboratory experiment that shows, for the first time, that the state of people's self-regulatory resources influences their reliance on the formal enforcement of norms in a social dilemma. The experimental subjects' self-regulatory resources are rigorously manipulated using well-known depletion tasks. On the one hand, when their resources are not depleted, most decide to govern themselves through monitoring and decentralized, peer-to-peer punishment in a public goods dilemma, and then successfully achieve high cooperation norms. On the other hand, when the amount of their resources is limited, the majority vote to enact a costly formal sanctioning institution and then construct deterrent punishment toward free riders; backed by formal punishment, groups achieve strong cooperation. A supplementary survey on the Covid-19 pandemic was conducted to enhance the external validity of the findings, generating a similar pattern. Self-control and commitment preference theories, combined with inequity aversion, can explain these patterns, because they predict that those with limited self-regulatory resources are motivated to remove temptations in advance as a commitment device, thus avoiding a large self-control cost. This underscores the role of commitment in the context of a social dilemma.

Keywords: Institutional choices, social dilemma, public goods, self-control, punishment
JEL classification: C92, D02, D72, D91, H41

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1. Introduction

Human societies and organizations experience many conflicts between private interests and socially optimal behaviors. Free riding problems in social dilemmas are typical examples of such conflicts. In a social dilemma, people may recognize the value of cooperation and therefore wish to achieve the Pareto-efficient outcome(s) through mutual cooperation. However, the temptation to free ride may be too strong for some to resist due to their self-control capacities (e.g., Gul and Pesendorfer, 2001, 2004; Baumeister *et al.*, 1994, 2007). Societies have ways to regulate opportunistic behavior through implementing formal institutions (e.g., Ostrom, 1990), thus removing harmful temptations as a commitment device in advance. However, it is unclear how people's self-control capacities are linked to institutional formation in their community, whether in groups, societies, or organizations.

For the last few decades, experimental studies have actively examined how formal (*a.k.a.* centralized) institutions can resolve social dilemmas, and when these institutions should be implemented (e.g., Falkinger *et al.*, 2000; Tyran and Feld, 2006; Kosfeld *et al.*, 2009; Putterman *et al.*, 2011; Traulsen *et al.*, 2012; Zhang *et al.*, 2014; Kamei *et at.*, 2015; Nicklisch *et al.*, 2016; Fehr and Williams, 2018; Kamei and Tabero, 2021). Prior research suggests that not only do formal sanctioning institutions theoretically alter people's materially beneficial behaviors, but they also indeed induce real people to make socially optimal choices (e.g., Falkinger, 1996; Falkinger *et al.*, 2000; Putterman *et al.*, 2011). However, it at the same time, research shows that formal institutions may not always be required to resolve dilemmas, because people may successfully govern themselves through decentralized monitoring and peer-to-peer punishment (e.g., Fehr and Gächter, 2000, 2002; Masclet *et al.*, 2003; Gürerk *et al.*, 2006; Herrmann *et al.*, 2008; Gächter *et al.*, 2008; Casari and Luini, 2009; Ertan *et al.*, 2009). Several studies have investigated people' choices between formal and informal sanctioning institutions, and have found that groups prefer to use a formal institution to a decentralized solution only under certain conditions, such as when the use of a formal institution does not entail a large cost (e.g., Kamei *et at.*, 2015), when anti-social peer-to-peer punishment is more severe than possible enforcement errors by a centralized authority (e.g., Nicklisch *et al.*, 2016), or when a normative consensus is difficult to reach through a decentralized mechanism (e.g., Fehr and Williams, 2018). However, no studies have explored how people's self-control capacities, or more precisely, *self-regulatory resources*, are linked to their need for formal institutions in social dilemmas.

Self-regulatory resources are internal resources that people use to regulate their self-control, cope with stress and attention, and deal with conflicts between selfish and pro-social motivations. A large volume of experiments in neighboring fields of economics has consistently demonstrated, since around 1990, that (a) people's decision-making is strongly influenced by the state of their self-regulatory resources, and (b) the self-regulatory resources are *limited*, meaning that the resources are depleted once used for some activities (see, e.g., Baumeister *et al.* [1994, 2007] and Muraven and Baumeister [2000] for a survey). Responding to the solid empirical evidence and great economic importance of self-control (e.g., overeating, consumption, borrowing, and procrastination), economists have joined the research and rigorously formalized people's self-control preferences (e.g., Gul and Pesendorfer, 2001, 2004; Fudenberg and Tirole, 2006; Dekel *et al.*, 2009). Recently, economic experiments have also verified that

self-control preferences are indeed prevalent, and that some people may want to remove strong temptations in advance if they anticipate that they will succumb to them and if removing them may improve their welfare (e.g., Bucciola *et al.*, 2011; Burger *et al.*, 2011; Houser *et al.*, 2018; Toussaert, 2018; Kocher *et al.*, 2017). While self-control and commitment theories may be applicable in the context of institutional formation in societies or organizations, surprisingly, this possibility has not been considered thus far.

How to implement a formal institution, such as formal punishment, is clearly a difficult but important issue. While such questions are ubiquitous and commonly raised in modern societies, identifying people's institutional preferences and the effects of policies is challenging. One example is restrictions related to the Covid-19 pandemic (which started in early 2020). Several countries, such as those in North America, Europe and Asia, enacted lockdowns or similar restrictions when the pandemic became serious. People's behavioral patterns during the pandemic did resemble a self-regulatory depletion phenomenon. For example, Japan declared a state of emergency four times in the Tokyo area, and implemented strict restriction measures.[1] Based on data on people flow, however, the impacts of such restrictions diminished over time. For instance, on the first weekends following the declaration of the second, third, and fourth states of emergency, crowd numbers in Shibuya Center Street were found to be 50, 50, and 88 percentage points larger, respectively, than those on the first weekend following the declaration of the first state of emergency (Rei Frontier, Inc., July 2021). The news repeatedly announced that this kind of phenomenon was due to "Jishuku zukare" (which means exhaustion from extreme self-control, e.g., staying home), and emphasized that the state of emergency had become increasingly less effective. A survey conducted by the Cabinet Office in Spring 2021 indicated that 71.6% of the respondents agreed that they were exhausted from self-control.[2] Something similar occurred in almost every country. In the United Kingdom (UK), many citizens strictly followed social distancing measures and wore face coverings during the first lockdown. However, they gradually stopped following such measures or government recommendations. They even tended to oppose restrictions when another wave later came. A survey, for example, showed that the percentage of those who were willing to self-isolate if advised decreased from 95% in April 2020 to 87% in April 2021 (Imperial College London, 2021). Parallel to people's attitudes, the country gradually shifted in the direction of living with the coronavirus without (strong) restrictions.

Nonetheless, this kind of interpretation may be misleading, because the Covid-19 restriction measures were weaker in later lockdowns/states of emergency. Thus, the pattern described above may simply mean that people's degrees of self-control are merely positively correlated with the strength of restriction measures. This opposite causation is similar to the well-known example of endogeneity, demonstrated by Levitt (1997), for the positive correlations between crime rates and the sizes of police forces in cities in the United States (US) (see Hoxby [2000] for another example). As policymaking in democratic countries such as Japan and the UK reflects people's views, the weaker restriction measures in

[1] The first state of emergency was from April 7 to May 25, 2020; the second one was from January 8 to March 21, 2021; the third was from April 25 to June 20, 2021; and the fourth was from July 12 to Sep. 30, 2021.
[2] https://www5.cao.go.jp/keizai2/wellbeing/covid/pdf/result3_covid.pdf (in Japanese; accessed on Feb. 7, 2022)

a later Covid wave may mean that, *contrary* to self-control theory, people do not have commitment preferences when their self-regulatory resources are limited (i.e., when they cannot resist the temptation to go out due to, perhaps, self-regulatory depletion). Identifying people's commitment preferences is complex, nevertheless; some unobserved individual characteristics, or omitted variables, might affect both people's self-control behaviors and their support for weak restriction measures through democratic processes. Uncertainty about the fatality of the coronavirus was also gradually resolved over time, which made comparisons of revealed behaviors between different points of time less straightforward. People's concerns were not limited to their health and safety, as Covid-19 restrictions also both impacted labor markets and their incomes. Indeed, there is some indication of people's commitment preferences: Conducted in June 2021, an opinion survey by the Yomiuri newspaper found that (a) the percentage of those who supported changing the Japanese constitution increased from 49% in 2020 to 56 % in 2021, and (b) 59% of the respondents agreed that the government's control rights and power should be strengthened in an emergency such as the Covid-19 crisis. In June 2021, an opinion survey by Jiji Press indicated that 53.7% (20.7%) of their respondents agreed (disagreed) to creating a clause in the constitution to strengthen the government's power in an emergency. However, it is unclear who, those with strong or weak self-control, support such stronger formal enforcement. In addition, "emergency" in these surveys includes not only the Covid-19 crisis, but also any other crisis, such as a possible war with a country neighboring Japan or natural disaster.

A similar difficulty arises when this research question is examined based on an existing cross-country dataset. For example, the World Value Survey (WVS) Wave 7 (2017-2020) collected responses regarding what children were encouraged to learn at home, such as good manners and tolerance—see Q7 to Q17 of the survey. As people are known to build self-regulatory resources in their lifetime (e.g., Baumeister *et al.*, 1994, 2007; Muraven and Baumeister, 2000), education to exercise self-control in early stages can be a proxy for their self-regulatory strength as a nation. The WVS also collected views on government interventions by asking respondents to rate them on a 10-point scale: 1 = The government should take more responsibility to ensure that everyone is provided for, and 10 = People should take more responsibility to provide for themselves. A pairwise Pearson's correlation between the percentage of affirmative answers in Q7 to Q17 and the view on the government intervention was calculated as significantly negative (correlation = -0.0247, $p < 0.0001$). Thus, those more educated to build self-control in their childhood appear to ultimately support greater government responsibility. Furthermore, those who are more educated in self-control are significantly less confident with the current level of law in their nations.[3] These patterns are again *opposite* to those suggested by self-control theory, as the theory postulates that those who *lack* self-control want stronger interventions as a commitment device. These interpretations, nevertheless, may be incorrect due to endogeneity issues (e.g., omitted variable bias), or heterogeneity, typical of cross-country analyses.

An advantage of using a laboratory experiment is its control. It is possible to study people's

[3] The percentage of the respondents' affirmative answers in Q7 to Q17 are significantly and negatively correlated with their average confidence levels on the police, courts, and government in the WVS (Q69, Q70, and Q71).

preferences between formal and informal institutions without suffering from econometric issues. With a carefully constructed design, this study provides the first experimental evidence that the state of people's self-regulatory resources does influence their reliance on the formal enforcement of norms in a social dilemma, as self-control and commitment theories, combined with inequity aversion, suggest. The recruited human subjects' self-regulatory resources are rigorously manipulated using two depletion/non-depletion tasks from the literature: the crossing-out-letters (Baumeister *et al.*, 1998) and Stroop (1997) tasks. When their self-regulatory resources are *not depleted*, most decide not to introduce a costly formal sanctioning institution in a public goods game ("PGG," hereafter); however, they then successfully cooperate with one another through decentralized monitoring and peer-to-peer punishment. In contrast, when they *are forced to deplete* their self-regulatory resources, the vast majority vote to implement a costly formal institution, and then construct a deterrent punishment toward free riders. The deterrent punishment has a strong effect in sustaining cooperation. These results, therefore, emphasize that people's demands for formal sanctioning institutions in a social dilemma depend on the amount of their self-regulatory resources.

While the finding is quite convincing, one may be concerned about its external validity due to the neutral framing design of the laboratory experimental approach. Although the laboratory approach is standard and its usefulness is already well established, the present study additionally conducts a survey (opinion) to supplement the main experiment summarized above by collecting respondents' self-control behaviors and their opinions on the restriction measures during the Covid-19 crisis. The results obtained about their preferences in the field are consistent with our observations in the laboratory experiment: those who exhibit weaker self-restraint behavior during the Covid-19 pandemic prefer more to rely on formal restrictions and sanctioning institutions to deal with the cooperation problem during the pandemic.

The rest of the paper proceeds as follows: Section 2 briefly summarizes the related literature, while Section 3 describes the experimental design. Section 4 presents hypotheses based on theoretical analysis, while Section 5 reports the experimental results. Section 6 briefly explains the results of the supplementary survey. Section 7 concludes.

2. Related Literature

Two branches of the literature in the social sciences are closely related to the present study: (a) social dilemmas, and endogenous choices of institutions, and (b) self-control and self-regulatory resources. The branch in (a) emanates from economic experimental research, while that in (b) arises from theoretical suggestions and experimental evidence in economics, as well as laboratory studies in neighboring fields such as psychology.

First, there is a large volume of experimental research that examines not only the human behavioral tendency to cooperate, but also institutions in sustaining cooperation in social dilemmas. People's social dilemma behavior is often studied using a PGG —the game adopted in this study, and among the most frequently used games in the literature. In a PGG, human subjects are randomly assigned to a group of N, where $N > 2$, are given endowments, and then simultaneously decide how many points to contribute to their group. Parameters are set such that members' privately optimal contribution levels are

smaller than the socially optimal level. The socially optimal contribution level is often set at the full endowment amount (i.e., linear public goods game); however, it is sometimes set at an interior level (i.e., non-linear public goods game). The PGG emulates many social dilemma situations, e.g., whether to litter, to comply with laws and ordinances, or to follow norms such as recycling and fulfil civic duties. Prior research indicates that tension between cooperation and free riding is intense. For instance, while some people attempt to cooperate with their peers, they learn to behave uncooperatively as they gain experience (e.g., Ledyard, 1995; Chaudhuri, 2011). Thus, some institutions are required to sustain cooperation, unless interactions are infinitely repeated.

There are two kinds of institutions that can facilitate cooperation. The first kind is to utilize a *centralized* or *formal* institution, which aligns members' private interests with group interests using deterrent incentives (e.g., Falkinger *et al.*, 2000; Tyran and Feld, 2006; Kosfeld *et al.*, 2009; Putterman *et al.*, 2011; Traulsen *et al.*, 2012; Zhang *et al.*, 2014; Kamei *et at.*, 2015; Nicklisch *et al.*, 2016; Fehr and Williams, 2018; Kamei and Tabero, 2021). For example, in Tyran and Feld (2006), while subjects contributed only 30% of the endowment in a standard linear PGG with free riding being the strictly dominant strategy, they on average contributed 93% of the endowment when a deterrent penalty scheme changed the equilibrium behavior to full contribution. Similarly, Falkinger (1996) and Falkinger *et al.* (2000) showed, theoretically and experimentally, that a redistribution mechanism (which taxes free riders while subsidizing high contributors) can lead to almost full efficiency. Furthermore, given an option to construct a mechanism, most subjects can build a deterrent one, thereby achieving a Pareto-efficient outcome (e.g., Putterman *et al.*, 2011; Kamei *et al.*, 2015).[4]

An alternative to a centralized solution is to rely on decentralized, peer-to-peer monitoring and punishment (e.g., Fehr and Gächter, 2000, 2002; Masclet *et al.*, 2003; Gürerk *et al.*, 2006; Herrmann *et al.*, 2008; Gächter *et al.*, 2008; Casari and Luini, 2009; Ertan *et al.*, 2009). The standard theoretical prediction of free riding in PGGs does not change when decentralized punishment is available, based on agents' self-interest and common knowledge of rationality. However, experiments have demonstrated that members' informal punishment strongly improves efficiency, for as long as the costs to the punishers are not too high (e.g., Anderson and Putterman, 2006; Nikiforakis and Normann, 2008) and the interactions are sufficiently long (e.g., Fehr and Gächter, 2000, 2002; Gächter *et al.*, 2008). Various sets of authors have experimentally examined the factors that may explain people's informal punishment activities. Their explorations have successfully found non-material motives, for example, negative emotions (e.g., de Quervain *et al.*, 2004), inequity aversion and beliefs in peers' punishment (e.g., Fehr and Fischbacher, 2004; Fischbacher and Gächter, 2010), a conditional willingness to punish (e.g., Kamei, 2014), enjoying punishment activities (e.g., Casari and Luini, 2009), and culture and nationality (e.g., Hermann *et al.*, 2008). Interdependent preference models, such as inequity aversion (e.g., Fehr and Schmidt, 1999 and 2010) and reciprocity (e.g., Rabin 1993, Charness and Rabin 2000), can theoretically rationalize human punishment behavior and its behavioral effects. The high efficiency of decentralized solutions may mean

[4] Kamei and Tabero (2021) show that decision-making formats may also affect their voting behavior. They find that as a decision-making unit, "teams" vote more efficiently than "individuals" to deter free riding.

that groups do not need centralized solutions under certain conditions.

For the last decade, scholars have actively examined people's scheme preferences and the conditions under which groups enact formal, rather than informal, schemes for governance (e.g., Traulsen *et al.*, 2012; Andreoni and Gee, 2012; Zhang *et al.*, 2014; Kamei *et at.*, 2015; Nicklisch *et al.*, 2016; Fehr and Williams, 2018; Kamei and Tabero, 2021). The findings suggest that groups do delegate sanctioning power to a central authority by voting when formal schemes do not entail a large fixed (e.g., administrative) cost (e.g., Kamei *et at.*, 2015), when members' anti-social peer-to-peer punishment is more harmful than erroneous enforcement by the formal authority (e.g., Nicklisch *et al.*, 2016), and when members cannot reach a normative consensus regarding contribution behaviors in their group (Fehr and Williams, 2018). The endogenous selection of institutions has additional positive effects in fostering cooperation norms by not only allowing sorting (e.g., Dal Bó *et al.*, 2010; Dal Bó *et al.*, 2019), but also by directly influencing members' preferences for cooperation or providing them with an opportunity to signal through voting (e.g., Tyran and Feld, 2006; Dal Bó *et al.*, 2010; Sutter *et al.*, 2010; Kamei, 2016, 2019). Despite numerous studies in this area, all prior experiments on institutions were conducted without considering the subjects' self-control capacities. The present study is, to the author's knowledge, the first to examine how the amount of people's self-regulatory resources influences their scheme choices and efficiency in a novel design that manipulates their regulatory resources in a laboratory.

The second closely related area involves theoretical and experimental studies on self-control and temptation. For at least the last forty years, many scholars in psychology and its neighboring fields have consistently demonstrated that human self-regulatory recourses are limited, and therefore people tend to succumb to temptation when the resources are used up—a phenomenon called "self-regulatory depletion" (see, e.g., Baumeister *et al.* [1994, 2007] and Muraven and Baumeister [2000] for a survey). One important feature here is that self-regulatory resources are used to control and manage *all* kinds of urges and temptations: if a person uses the regulatory resources to suppress some temptations in one dimension, they may not be able to resist temptations in other dimensions since the resources will have diminished. The self-regulatory hypothesis is relevant for many economic transactions because people usually face conflicts in their economic decision-making: e.g., their individual decision-making, such as consumption choices and borrowing, and their social decision-making, such as whether to cooperate in a social dilemma, trust or betray others, etc.

Since around 2000, economists have followed scholars in these other social science fields on self-control research due to its significant importance in economics. Gul and Pesendorfer (2001, 2004) and many other prominent theorists first made breakthroughs by formally modeling human self-control behaviors and people's tendency to commit. In particular, Gul and Pesendorfer (2001) axiomatize self-control preferences by introducing a new axiom, "set betweenness," in an expected utility framework. Their representation theorem states that an agent incurs a self-control cost in choosing an action if there are some other tempting options in the choice set (see also Dekel *et al.* [2009]). The agent, therefore, has a *commitment* preference, i.e., they prefer to narrow their choice set in advance by removing tempting options from the menu. While the self-control theory by Gul and Pesendorfer (2001) provides dynamically consistent preferences, and therefore does not explain psychologists' idea of *limited* self-

regulatory resources and depletion, its variant, i.e., the addiction model (Gul and Pesendorfer, 2007; Kamei, 2012), and multi-self models (e.g., Ozdenoren *et al.*, 2011; Fudenberg and Levine, 2006), can explain self-regulatory depletion.

Experimental testing of human self-control behavior and commitment preferences was conducted relatively recently in economics (Bucciola *et al.*, 2011; Burger *et al.*, 2011; Houser *et al.*, 2018; Toussaert, 2018; Kocher *et al.*, 2017). Houser *et al.* (2018) and Toussaert (2018) serve as direct tests of Gul and Pesendorfer (2001)'s self-control theory. Indeed, both experiments revealed self-control and commitment preferences among some individuals. First, Toussaert (2018) found that self-control preferences were potentially dynamically consistent. In her experiment, subjects who worked on a tedious task while facing a temptation (i.e., to read a story during a task) were classified by whether they wanted to eliminate the temptation. A quarter to a third of the subjects were classified as the "self-control type" (those who believed in their successful self-control without such elimination), and did indeed resist the temptation during the task. A similar finding was obtained in an experiment by Kocher *et al.* (2017). Kocher *et al.* indicate that the stronger the self-control people have, the higher the level of cooperation they can achieve in a PGG. Second, Houser *et al.* (2018) let subjects decide whether to perform a real effort task ("counting" task) or surf the internet, with an option to commit to working by paying a fee to eliminate the internet surfing option. Some subjects did use the costly commitment option. Houser *et al.* (2018) also documented that self-control behavior might potentially be dynamically inconsistent when temptations were sufficiently strong,[5] as there were some subjects who delayed a commitment decision or succumbed to the temptation at a later stage. This is similar to the self-regulatory depletion phenomenon (Houser *et al.*'s experiment had a demanding, two-hour, task-solving task). The self-regulatory depletion possibility was carefully addressed by Bucciola *et al.* (2011). Bucciola *et al.* let children (aged 6 to 13) fold as many sheets as possible while including the so-called "Marshmallow task" in the experiment. Their result showed that exposure to consumption temptations (e.g., a snack) significantly undermined younger children's productivity. In the context of the present study, using formal enforcement is linked to people's commitment preferences in social dilemmas as it makes free riding materially unbeneficial. However, no study has investigated how people's self-regulatory resources influence their voting behavior and institutional formation outcomes. This study is the first to examine how the amount of people's self-regulatory resources affects their activation of formal enforcement, rather than their decentralized self-governance, in the context of endogenous institutional formation when there is tension between contributing and free riding. The amounts of subjects' self-regulatory resources are manipulated using well-established depletion tasks from the literature.

3. Experimental Design

The experiment is built on the framework of a finitely repeated linear PGG. Subjects are randomly assigned to a group of five, and the grouping stays the same throughout the experiment (partner matching). Each subject in a group has an endowment of 20 points in every period, and then

[5] It is worth acknowledging that self-control behavior may be driven by a complex mechanism, as Burger *et al.* (2011) found that commitment devices might be counterproductive in the context of procrastination.

simultaneously decides how many points to allocate between their public and private accounts. The marginal per capita return (MPCR) is 0.4. In other words, Subject *i* receives the following payoff in Period *t* when they contribute $c_{i,t}$:

$$\pi_{i,t}(c_{i,t}) = 20 - c_{i,t} + r\sum_{j=1}^{5} c_{j,t}, \text{ where } r = 0.4. \quad (1)$$

Four treatments are implemented as a 2×2 between-subjects design (Table 1); each subject plays the game under only one treatment condition. This feature is important because subjects' experience in one environment may spill over to their behaviors in another environment—a phenomenon called "behavioral spill-over" (e.g., Kamei, 2016; Bednar *et al.*, 2012).[6] The first treatment dimension of the 2×2 design is the amount of subjects' self-regulatory resources. The second treatment dimension is whether subjects have an opportunity to enact sanctioning schemes by voting. In the treatments with institutional choices, groups decide which scheme to implement, either a formal sanctioning scheme ("FS," hereafter) or an informal sanctioning scheme ("IS," hereafter).

Table 1: *Treatments*

Treatment	Voting	Self-regulatory resources	Part 2 Condition for PGG
No-N	No	Not depleted (Normal)	Six phases without sanction scheme
No-D	No	Depleted (Small)	Six phases without sanction scheme
Voting-N	Yes	Not depleted (Normal)	Six phases each with FS or IS scheme
Voting-D	Yes	Depleted (Small)	Six phases each with FS or IS scheme

All treatments comprise Parts 1 and 2. Part 1, also called Phase 1, is the same for the four treatments. In Part 1, subjects play the PGG described above four times in sequence without institutional choices, as in Kamei *et al.* (2015). Subjects' payoffs in each period are calculated based on Equation (1). This part plays a role in familiarizing subjects with peers' incentives to free ride (e.g., Ledyard, 1995; Chaudhuri, 2011). Part 2 has six phases (each comprising four periods) and differs by treatment. The six phases are called Phases 2 to 7 (Periods 5 to 28) in the study. Having multiple phases allows us to examine how experience affects institutional choices.

The two treatments without institutional choices are called the "No Voting, No Depletion" (No-N) and "No Voting, Depletion" (No-D) treatments. Part 2 of the No-N treatment begins with a task without depletion, followed by six phases, each with a four-period standard PGG. By contrast, subjects in the No-D treatment are *forced to deplete* their self-regulatory resources. Part 2 of the No-D treatment begins with a task parallel to the No-N treatment; however, the task contains an element that affects the self-regulatory resources, whereafter the six phases of interactions commence (the depletion task will be explained in Subsection 2.1). There is an additional depletion task in each period of Part 2, to maintain the

[6] Most research in this area used a between-subjects design (e.g., Traulsen *et al.*, 2012; Andreoni and Gee, 2012; Zhang *et al.*, 2014; Kamei *et at.*, 2015; Nicklisch *et al.*, 2016; Fehr and Williams, 2018; Kamei and Tabero, 2021; Tyran and Feld, 2006; Dal Bó *et al.*, 2010; Sutter *et al.*, 2010; Kamei, 2016).

manipulated state of self-regulatory resources throughout. A schematic diagram of the two treatments is shown in Panel A of Figure 1.

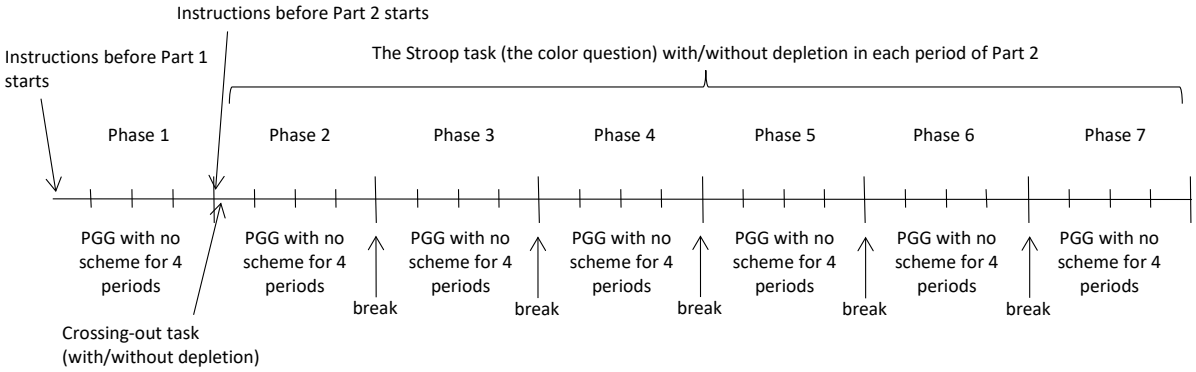
The two treatments with institutional choices are called the "Voting, No Depletion" (Voting-N) and "Voting, Depletion" (Voting-D) treatments. The structures of the Voting-N and Voting-D treatments are the same as those of the No-N and No-D treatments, respectively, except for the opportunity to choose institutions. The Voting-N (Voting-D) treatment has the same no-depletion (depletion) tasks as the No-N (No-D) treatment. A schematic diagram of the voting treatments is shown in Panel B of Figure 1.

In Part 2 of the Voting-N and Voting-D treatments, subjects can use a sanctioning scheme in each period of public goods interactions. The design for the institutional setting follows Kamei *et al.* (2015). At the onset of each phase, groups can select an FS or an IS by voting. Whichever scheme receives at least three votes (i.e., majority voting) will be in effect for the four periods in the given phase. Voting is cost-free and mandatory. Period structures vary by scheme. When a group selects the IS scheme, each period comprises two stages: an allocation stage, and an informal (peer-to-peer) punishment stage. The first allocation stage is the same as the allocation stage in Phase 1: each member decides how to allocate 20 points between their private and public accounts. When all the members have made their allocation decisions, they will be informed of each member's contribution amount, and will then be provided with an opportunity to assign punishment points to one another. These are costly punishment decisions; for each punishment point assigned to a member, one point is deducted from the punisher while three points are deducted from the punished. There are two requirements for the punishment decisions: First, the punishment points assigned to each member must be an integer. Second, the punishment points must be less than or equal to 10 for any one member of their group.

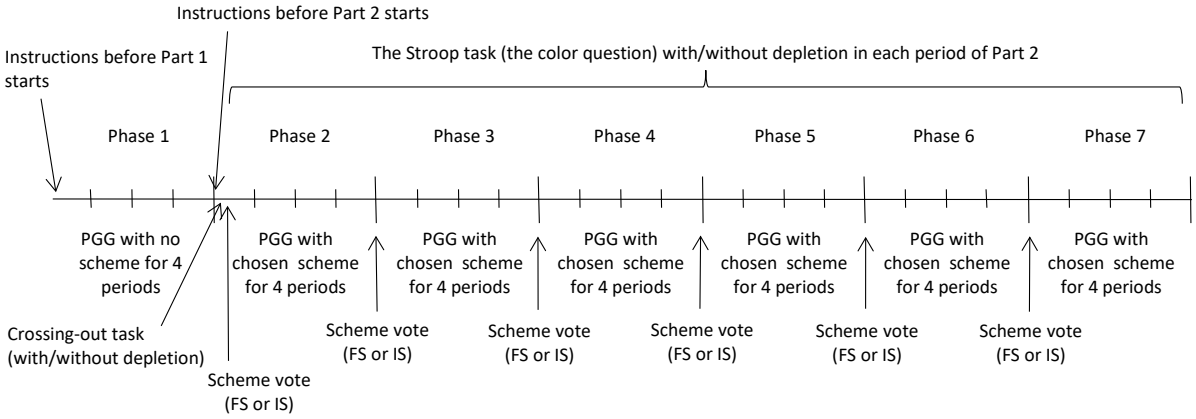
When a group selects the FS scheme, each period comprises two stages: a voting stage, and an allocation stage under the enacted FS scheme. Allocations to their private accounts are penalized in the FS scheme. The punishment strength is set such that it is equivalent to the IS scheme: the cost ratio is 1:3 (punisher: punished). At the beginning of each period, the members vote on the sanction rate to be used. There are four possible rates: {0.0, 0.4, 0.8, 1.2}. The median of the five votes will be enacted in their group. The second stage is the allocation decision stage as in each period of Part 1, but subject to the FS scheme. There are two costs under the FS scheme. First, every subject must pay an administrative fixed cost of having the scheme, $f = 5$, in each period, irrespective of whether formal punishment is inflicted (hence, the aggregate fixed cost per group is large, such that $5 \times 5 = 25$). This means that, while the comparative advantage of having an FS mechanism relative to an IS one is to enforce punishment precisely on free riders, it entails a large cost. The fixed cost can be thought of as a cost to eliminate the temptation to violate social norms in the public goods dilemma. Using the two treatments, this study asks whether subjects prefer to commit to cooperation by collectively selecting a deterrent sanction scheme when self-regulatory ability is dominated by the size of free riding temptations, as proposed by the self-control theory (e.g., Gul and Pesendorfer, 2001 and 2004). More specifically, this study asks, do subjects prefer using IS when they have sufficiently large self-regulatory resources? What happens to their choices between FS and IS when their resources have been depleted?

The second cost is variable costs. For each point lost by a member who is fined, every group member incurs a cost of 1/11 points to impose that punishment. This cost is interpreted as the administrative cost of imposing the fine. The punished thus incurs a loss of 12/11 (=1+1/11) in total, while the four punishers incur a loss of 4/11. The ultimate cost ratio is 3:1 (12/11: 4/11). In other words, the FS and IS schemes have the same punishment cost ratios. Note, however, that the two schemes have different aspects. First, as already discussed, the FS scheme requires *fixed* administrative cost payments, in contrast to the IS scheme. Second, punishment is only targeted at free riders with collectively agreed strength in the FS scheme. In contrast, peer-to-peer punishment in the IS scheme depends on members' decisions; thus, it is possible that free riders may not be effectively punished, and that high contributors may also be punished.

Figure 1: *Schematic Diagram*



(A) No-D and No-N treatments



(B) Voting-D and Voting-N treatments[#1]

Notes: [#1] When a group selects the FS scheme in a given phase, it decides a sanction rate by voting in each of the four periods in that phase. In other words, they have four voting opportunities in that phase.

3.1. Depletion task

Two depletion tasks are used: one at the beginning of Part 2, and the other during the 24-period PGG of Part 2 (again, see Figure 1). While the former depletion task is used to manipulate the amount of self-regulatory resources before the public goods interactions begin in Part 2, the latter plays a role in

maintaining the depleted state at low levels. The literature states that people may recover from self-regulatory depletion and regain the ability to exercise self-control if a sufficiently long time passes after the depletion or if they experience a positive mood. For example, successful cooperation with deterrent punishment in Part 2 may help subjects recover their resources. Thus, including the latter task can manipulate the amount of self-regulatory resources throughout Part 2. Having the mental state depleted is also useful for real-world relevance in modeling people's smaller amounts of resources for a particular temptation in some societies (e.g., people may generally have smaller amounts of resources, and thus may tend to succumb to temptations such as littering [e.g., see the serious littering issue in the UK]; people may be tricked by moneylending businesses in a black market, which explains why strict regulations are required for some countries; addiction and drug use may also be related to self-regulatory resources, although these are more complicated due to the psychopathological symptoms that occur inside the brain).

This study uses the crossing-out-letters task ("crossing-out task," hereafter) to manipulate subjects' self-regulatory resources at the onset of Part 2. Hagger *et al.* (2010) performed a meta-analysis of depletion tasks in the literature, suggesting that the crossing-out task is one of the most effective (Deng [2018] provides an updated meta-analysis). For example, Achtziger *et al.* (2016) and Gerhardt *et al.* (2017) used the crossing-out task following the suggestions by Hagger *et al*. (2010).

In the experiment, the subjects perform the crossing-out task for eight minutes, although the rule differs by treatment. The subjects in the no-depletion condition (i.e., the No-N and Voting-N treatments) cross out every letter *e* in a paragraph (from a well-known book) appearing on the computer screen, one by one, and then submit the number of *e*'s. Once a subject submits an answer, a new paragraph appears on the computer screen. The paragraph is not short (see Appendix A.3), and thus it is not easy to answer the question correctly. However, self-regulatory resources are not required since the task rule is simple. By contrast, the subjects in the depletion condition (i.e., the No-D and Voting-D treatments) cross out *e*'s, *except* if a vowel precedes it by two letters or if it is immediately followed by a vowel (the same rule was used in, e.g., Baumeister *et al.* [1998] and DeWall *et al.* [2011]). As in Baumeister *et al.* (1998), the paragraph flashes in the depletion condition, thereby requiring extra attention by the subjects (and thus further depleting their mental resources). There are at most six paragraphs (one per screen) in this task. Subjects will be paid one point for each paragraph they answer correctly. While making this task incentive-compatible is crucial for encouraging subjects to seriously answer the questions (leading to successful manipulation of the self-regulatory resources), the compensation is set at a minimum value to avoid the effects of receiving compensation (if any) on subsequent behaviors.

Further, the so-called Stroop task (1992) is included during the public goods interactions to maintain the depleted state. In each allocation decision stage of Part 2, one of the four words ("red," "blue," "purple," and "black") randomly appears on the bottom of the computer screen. In the depletion condition, the word has a color, either red, blue, purple, or black, while the color does *not* necessary coincide with the meaning of the word (e.g., the word "red" appears in blue). Moreover, the word flashes, thus affecting subjects' attention. The coloring of the words is randomized. Subjects must answer in which color the word appears, along with the allocation decision in the PGG (see Appendix A for a screen image). For example, the answer is red if the word "blue" appears in red. By contrast, in the no-depletion condition, coloring

always coincides with the meaning of the words (e.g., the word "red" appears in red), and the word does not flash.[7] Thus, subjects can answer the color questions without using any self-regulatory resources. A subject receives one point for each correct answer in the Stroop task (the subject can earn up to 24 points as there are 24 periods in Part 2).

4. Hypothesis

The standard theory prediction based on players' self-interest and common knowledge of rationality is straightforward because the experiment design uses a finitely repeated game. With the logic of backward induction, no one would contribute any points to their public account in each period of the no-voting treatments since free riding is each player' strictly dominant strategy in the game ($\partial \pi_i / \partial c_i = -0.6 < 0$). Thus, complete free riding is the unique sub-game perfect Nash Equilibrium in the No-N and No-D treatments. In equilibrium, each player receives a payoff of 20 (= 20 + 0 × 5 × 0.4) points per period. Having the IS scheme does not alter the free-riding equilibrium in the voting treatments, since the standard theory predicts that no one will inflict punishment due to the cost (e.g., Fehr and Gächter, 2000, 2002).

However, the theoretical prediction under the FS scheme is different from that under the no-scheme condition or the IS scheme in the voting treatments (e.g., Falkinger *et al.*, 2000; Kamei and Putterman, 2015). When the FS scheme is in effect, it is materially beneficial for each player to vote for a sufficiently strong sanction rate, i.e., 0.8 or greater, so that contributing everything to their public account becomes the strictly dominant strategy (e.g., Putterman *et al.*, 2011). Recall that the MPCR in the PGG is 0.4. Note that while a median voting rule is used, the possibility of error (trembling-hand perfection) encourages all members to vote for a deterrent rate since any one's vote can then be pivotal—see Selten (1975). By enacting a deterrent sanction rate, each player obtains a payoff of 35 (= 0 + 20 × 5 × 0.4 – 5), rather than of 15 (= 20 + 0 × 5 ×0.4 – 5). This difference in the equilibrium behavior implies that, given an option to vote and the possibility that their votes are pivotal, all subjects would vote in favor of the FS scheme with the aim of enforcing deterrent sanction rates thereafter.

4.1. The Self-Control Model

The present experiment manipulates subjects' self-regulatory resources by adopting the crossing-out and Stroop tasks. The effect of the self-control aspect can easily be incorporated into the theoretical analysis using the well-known self-control preference model developed by Gul and Pesendorfer (2001, 2004). The self-control model in itself, however, does not change the standard theory predictions just discussed. To see this, assume the following utility functional form (Gul and Pesendorfer, 2001):

$$U_i(S) = max_{x_i \in A}[\pi_i(x_i) - f \cdot 1_{FS} - SR \cdot (20 - x_i) \cdot 1_{FS} - c_i(x_i)],$$

[7] An alternative to the Stroop task could be an attention control task (e.g., Gilbert *et al.*, 1988; Masicampo and Baumeister, 2008; DeWall *et al.*, 2011; Ainsworth *et al.*, 2014). In the attention control task, (neutral) unrelated words, such as tree, forest, and water, appear randomly for 10 seconds each on the subjects' computer screens. The subjects in the depletion condition are instructed not to see the words and will be reminded during the experiment whether they see them, while, in the no-depletion condition, the subjects are not given any instructions for the words. Implementing this task would be more difficult than using the Stroop task because it is often difficult for experimenters to judge whether subjects see the words during the experiment. Therefore, the attention control task was not adopted in the present study.

$$\text{where } c_i(x_i) = \max_{y\in A} v_i(y) - v_i(x_i) \equiv \rho_{i,s}\big(\max_{y\in A}[\pi_i(y) + SR\cdot y\cdot 1_{FS}] - \pi_i(x_i) - SR\cdot x_i\cdot 1_{FS}\big). \quad (2)$$

Here, *i* indexes individual players, $S \in \{FS, IS\}$, A is the choice set in the PGG, i.e., [0, 20], $\pi_i(x_i)$ is given by Equation (1), f is the fixed administrative cost (= 5), SR is the sanction rate enacted in the group, and $1_{FS} = 1(0)$ when the FS (IS) scheme is chosen. $c_i(x_i)$ is Player *i*'s self-control cost and $\rho_{i,s}$ indicates the state of *i*'s self-regulatory resources. The specific form of the self-control cost with $\rho_{i,s}$ was used in Kamei (2012), and $\rho_{i,s}$ is called the "temptation index." The subscript, *s*, in $\rho_{i,s}$ indicates the state of self-regulatory resources, i.e., *D* (Depleted) or *N* (Non-depleted). As self-regulatory depletion renders a player susceptible to temptation, such depletion is modelled by allowing the temptation index to enlarge (see also Ozdenoren *et al.* [2011]). Therefore, in this theoretical framework, it can reasonably be assumed that:

$$\rho_{i,D} > \rho_{i,N}. \quad (3)$$

In this self-control framework, Player *i* behaves the same under the FS scheme as the standard theoretical prediction described above. Notice that *i* and their group members would vote to enact deterrent sanction rates (SR = 0.8 or 1.2) for material reasons in the FS scheme. This means that individual interests are aligned with group interests in that scheme, by which they contribute full endowment amounts. Thus, the self-control cost is zero in a deterrent FS scheme. More formally, Player *i*'s payoff is calculated as 40 – f:

$$U_i(FS) = \max_{x_i\in A}\big[\pi_i(x_i) - \rho_{i,s}(\pi_i(20) + 20SR - \pi_i(x) - x\cdot SR) - f - SR\cdot(20 - x_i)\big]$$
$$= \pi_i(20) - f = 40 - f.$$

By contrast, individual private interests conflict with group interests in the IS scheme. Player *i* incurs a self-control cost accordingly: $c_i(x_i) = \rho_{i,s}(\pi_i(0) - \pi_i(x_i))$. This cost strengthens their motives to contribute nothing to their group (i.e., $x = 0$) under the IS scheme. In equilibrium, each player obtains 20 points as their payoff in the IS scheme, as follows:

$$U_i(IS) = \max_{x_i\in A}\big[\pi_i(x_i) - \rho_{i,s}(\pi_i(0) - \pi_i(x_i))\big]$$
$$= \max_{x_i\in A}\big[(1 + \rho_{i,s})\pi_i(x_i)\big] - \rho_{i,s}\pi_i(0)$$
$$= (1 + \rho_{i,s})\pi_i(0) - \rho_{i,s}\pi_i(0) = \pi_i(0) = 20.$$

In sum, the self-control model predicts that all groups in the Voting-N and Voting-D treatments choose the FS scheme, whereafter they enact deterrent sanction schemes by voting, and then contribute the full endowment amount in the allocation stage, as is the case for the standard theory prediction.

4.2. Incorporating Inequity-Averse Preferences in the Self-Control Model

For the last few decades, however, experiments have shown that *human* subjects behave differently from predictions based on self-interest and rationality (see Section 2). Especially, they can sustain cooperation with peers at a high level when peer-to-peer punishment is available (e.g., Fehr and Gächter, 2000, 2002), for as long as the punishment costs to the punishers are not too large (e.g., Anderson and Putterman, 2006; Nikiforakis and Normann, 2008). The positive effects of the IS scheme

can be explained by other-regarding preference models (see, e.g., Fehr and Schmidt [2006] and Sobel [2005] for a survey). For example, the inequity-averse preference model (Fehr and Schmidt, 1999, 2010) can successfully rationalize members' punishment behaviors and reactions to punishment received in social dilemma settings. The prevalence of inequity-averse preferences among people can also be seen in altruistic punishment by bystanders (e.g., Fehr and Fischbacher 2004; Kamei, 2020). Prior research on institutional choices further indicates that, given an option to vote, people do choose the IS scheme rather than the FS, and then sustain cooperation well under certain conditions, whose pattern is consistent with inequity aversion (e.g., Zhang *et al.*, 2014; Kamei *et al.*, 2015; Fehr and Williams, 2018; Kamei and Tabero, 2021).

This subsection shows that groups' scheme choices are theoretically affected by the members' states of self-regulatory resources, once their inequity-averse preferences are incorporated in the self-control model. Assume the following utility functional form, instead of Equation (2):

$$U_i(S) = max_{x_i \in A}\Big[\pi_i(x_i) - f \cdot 1_{FS} - SR \cdot (20 - x_i) \cdot 1_{FS} - \mu_i \sum_{j \neq i}\big(\pi_i(x_i) + SR \cdot x_i \cdot 1_{FS} - \pi_j\big(x_j\big) - SR \cdot x_j \cdot 1_{FS}\big)^2 - c_i(x_i)\Big],$$

$$\text{where } c_i(x_i) = \rho_{i,s}\big(\max_{y \in A}[\pi_i(y) + SR \cdot y \cdot 1_{FS}] - \pi_i(x_i) - SR \cdot x_i \cdot 1_{FS}\big). \quad (4)$$

Here, μ_i is Player *i*'s utility weight on income inequality.[8] Obviously, the inclusion of members' inequity aversion does not alter the prediction under the FS scheme, because individual and group interests are aligned with deterrent sanction rates; and $U_i(FS) = 40 - f$. Thus, the rest focuses on an analysis under the IS scheme while considering, for an illustrative purpose, a symmetric contribution situation. The assumption of symmetry significantly simplifies the analysis because no punishment is expected due to members' inequity concerns.[9]

The optimal behavior under the IS scheme is analyzed by finding the optional control x_i, i.e., the contribution level that maximizes the inside of the squared bracket of Equation (4). The first-order condition here is written as follows:

$$\frac{\partial U_i(IS)}{\partial x_i} = -1 + r - 2\mu_i(-1)\sum_{j \neq i}\big(\pi_i(x_i) - \pi_j(x_j)\big) + \rho_{i,s}(-1 + r)$$

$$= (-1 + r)\big(1 + \rho_{i,s}\big) + 2\mu_i \sum_{j \neq i}\big(-x_i + x_j\big). \quad (5)$$

Suppose that all *j* but *i* choose c^* as their contribution amounts: $x_j = c^*$. Then, if $\rho_{i,s}$ is sufficiently small such that $\frac{2\mu_i(N-1)}{(1-r)} - 1 > \rho_{i,s}$, *i* also chooses $x_i = c^*$ as their optimal response (thus, $x_k = c^*$ for all $k$holds as an equilibrium outcome).[10] In equilibrium, $U_i(IS) = \big(1 + \rho_{i,s}\big)\pi_i(c^*) - \rho_{i,s}\pi_i(0) = \big(1 + \rho_{i,s}\big)(20 - c^* + 0.4 \cdot 5 \cdot c^*) - \rho_{i,s}(20 + 0.4 \cdot 4 \cdot c^*) = 20 + (1 - 0.6\rho_{i,s})c^*$. Thus,

[8] This quadratic functional form was used in Kamei (2018)'s theoretical analysis.

[9] The strategic situation is the one with multiple equilibria when other-regarding motives are added to the model, thus making the analysis quite complex if we also consider the cases with asymmetric equilibria.

[10] If $x_i = c^* + 1$, the right-hand side of Equation (5) = $(-1 + r)\big(1 + \rho_{i,s}\big) - 2\mu_i(N - 1) < 0$. If $x_i = c^* - 1$, the right-hand side of Equation (5) = $(-1 + r)\big(1 + \rho_{i,s}\big) + 2\mu_i(N - 1) > 0$, provided that $\frac{2\mu_i(N-1)}{(1-r)} - 1 > \rho_{i,s}$.

whether the Pareto-dominant equilibrium ($c^* = 20$) also maximizes their utility level depends on the size of $\rho_{i,s}$, as the c^*that maximizes U_i depends on $\rho_{i,s}$ as follows:

$$\text{if } \rho_{i,s} < 5/3, \text{ then } c^* = 20 \text{ maximizes } U_i \text{ and } U_i(IS) = 40 - 12\rho_{i,s};$$

$$\text{if } \rho_{i,s} > 5/3, c^* = 0 \text{ maximizes } U_i \text{ and } U_i(IS) = 20.$$

Combined with the optimal behaviors in the FS scheme, it can be concluded that players prefer the FS (IS) scheme if they have sufficiently small (large) amounts of self-regulatory resources, i.e., $40 - f > (<) 40 - 12\rho_{i,s}$, meaning that $\rho_{i,s} > (<) 5/12$. Note that when $\rho_{i,s} > 5/3$, $U_i(IS) = 20$, which is always less than $U_i(FS) = 35$. These analyses can be summarized in Proposition 1 as the main hypothesis of this study. Since the amount of subjects' self-regulatory resources in the Voting-D treatment is small, the FS scheme is predicted to be more prevalent in the Voting-D treatment than in the Voting-N one.

Proposition 1: *The smaller the amounts of self-regulatory resources people have, the more strongly they rely on law enforcement. In the context of the present study, members vote for enacting the FS scheme more frequently in the Voting-D treatment than in the Voting-N treatment.*

5. Experiment Results

The experiment sessions were conducted face-to-face at the Experimental Economics Laboratory, Research Institute of Socionetwork Strategies at Kansai University, in November and December 2020 and July and August 2021.[11] A total of 175 students (45, 45, 40, and 45 subjects in the No-N, No-D, Voting-N, and Voting-D treatments, respectively), recruited through the ORSEE (developed by Greiner, 2015), participated in the experiment. No subjects participated in more than one session.

Appendix Table B.1 reports the performances in the crossing-out and Stroop tasks. It shows that the average scores in both the crossing-out and Stroop tasks are significantly better in the non-depletion than in the depletion treatments. While this is the expected pattern, however, the scores in the two tasks are economically very similar for the four treatments. This is also an expected result. Recall that answering the color questions correctly is not difficult even in the depletion condition, although additional effort and attention are required; moreover, accurately counting the number of *e*'s in the crossing-out task is difficult even in the non-depletion condition, since each paragraph is lengthy (Appendix A.3). This helps remove the possibility of wealth effects gained from the task as a confounding factor in examining the effects of the manipulation on subjects' institutional formation.

This section first describes the treatment differences in contribution and payoffs (Section 5.1), whereafter it examines subjects' scheme choice behaviors (Section 5.2). Lastly, their behavior under the enacted schemes is examined (Section 5.3).

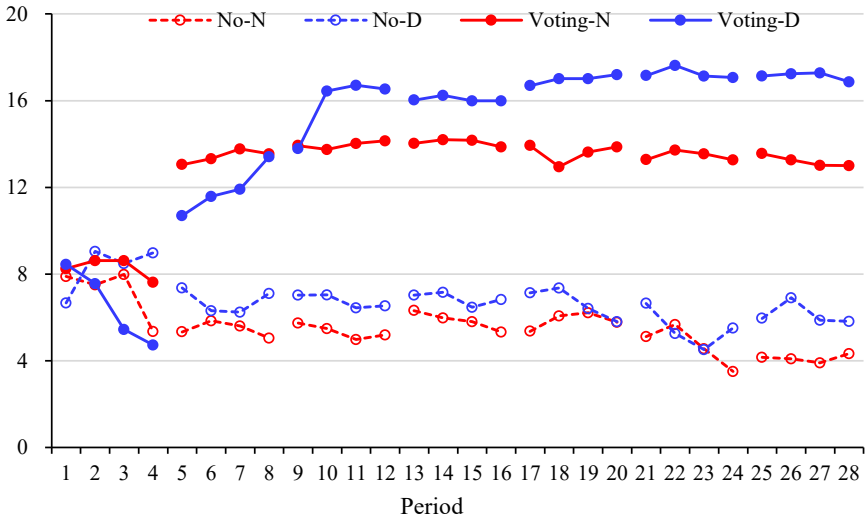
5.1. Contribution and Payoff

Figure 2 reports the contribution and payoff dynamics in each treatment. It shows that the

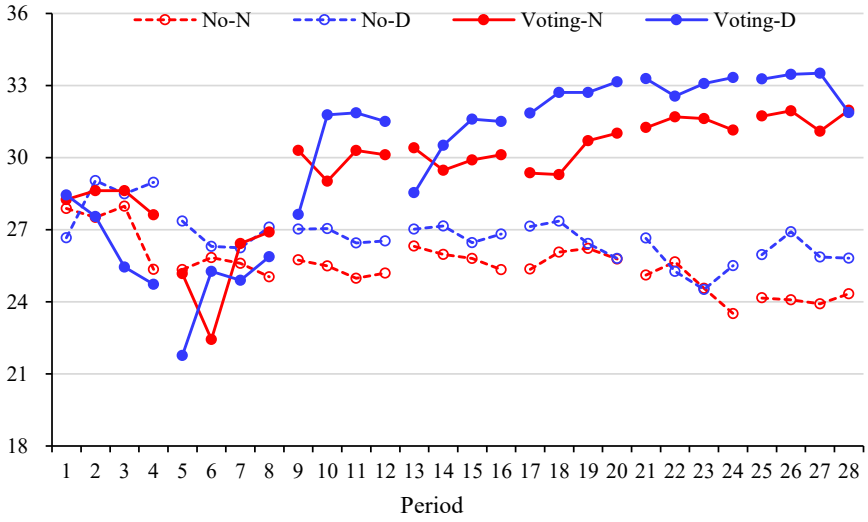
[11] This is a standard laboratory with three tall partitions in each desk: one for the front and two for the sides.

efficiencies are very similar in Part 1 for all four treatments. For example, the average contribution is less than 50% of the endowment in each treatment. A Mann-Whitney test finds that the differences in the average contribution or payoff are not significant for any comparison (Panel I.i of Appendix Table B.2). It follows that the random assignment in the experiment was successful, and that there was a large degree of free riding in each treatment without sanction schemes.

Figure 2: *Efficiency by Treatment*



(A) Average Contribution



(B) Average Payoff

The treatment effects of voting and self-regulatory resources on efficiency can be examined using the observations in Part 2. It shows first that, regardless of whether members' self-regulatory resources were depleted, free riding was serious when the sanction schemes were absent. Specifically, in both the No-N and No-D treatments, the average contributions were consistently less than 40% of the endowment, while the levels gradually declined over time. The difference in the average contribution in Part 2 is not

significant between the two no-voting treatments (two-sided $p = 0.2475$, Mann-Whitney test). A regression analysis finds a qualitatively similar result – see Part II of Appendix Table B.2.

Second, free riding was clearly deterred by the availability of sanction schemes (Panel I of Figure 2, Table 2). The effectiveness of punishment was not undermined by the state of members' self-regulatory resources. While in Part 1 the subjects in the Voting-N and Voting-D treatments experienced similar levels of free riding to those in the No-N and No-D treatments, the former achieved much higher levels of contributions in Part 2, thereby receiving larger payoffs, than the latter. The difference in the level of the average contribution or the average payoff is significant between the no-voting and voting treatments (Table 2 – see Part I of Appendix Table B.2 for more detailed results). A regression analysis, whether a linear or tobit regression model is used, finds a qualitatively similar result (Part II of Appendix Table B.2). This suggests that prior findings on the strong positive effects of punishment are robust to the amount of people's self-regulatory resources.

Nonetheless, a close look at the data indicates that the impact of voting on payoffs is somewhat weaker than that on contributions due to members' punishment loss. The impact is not significant for the Voting-N treatment (Panels I.iii and I.vi of Table B.2). The negative welfare effects of punishment are consistent with prior research: (a) punishment activities may be too intense under the IS scheme (e.g., Fehr and Gächter, 2000, 2002), and (b) a small number of groups may fail to construct a deterrent scheme and may therefore perform extremely poorly under the FS scheme (e.g., Group 13 of Putterman *et al.* [2011]). In contrast, such negative effects seem to be milder for the Voting-D treatment. For example, a significantly larger percentage of groups in Voting-D still received 30 points or greater as a payoff, compared with the No-D treatment. Here, the 30 points is the average payoff assuming that the average contribution in a group is 50% of the endowment and no punishments are inflicted. As will be explained later, this difference in efficiency between the Voting-D and Voting-N treatments is driven by (a) the large difference in the scheme choice outcome, and (b) the significantly stronger informal punishment activities seen in the Voting-D treatment relative to the Voting-N treatment.

Result 1: *(i) Free riding was serious in both the No-D and No-N treatments where the sanction schemes were absent. (ii) Voting on sanction schemes significantly improved cooperation regardless of whether the amounts of subjects' self-regulatory resources were small. The positive effects of voting were somewhat stronger in the Voting-D treatment than in the Voting-N treatment, nevertheless.*

Table 2: *Treatment Effects of Voting on Contributions and Payoffs*

	(i) No voting[#1]	(ii) Voting[#2]	Two-sided p-value for H_0: (i) = (ii)
(a) Avg. contribution in Part 1[#3]	7.739 points	7.362 points	0.916
(b) Avg. contribution in Part 2	5.836 points	14.809 points	0.0001***
(c) Avg. payoff in Part 2	25.836 points	30.259 points	0.0349**
(d) % of groups whose Part 1 avg. contributions were ≥ 10 points[#3]	37.778%	38.529%	1.000
(e) % of groups whose Part 2 avg. contributions were ≥ 10 points	28.472%	76.912%	0.0005***

(f) % of groups whose Part 2 avg. payoffs were ≥ 30 points	27.454%	65.343%	0.0016***

Notes: *p*-values were calculated based on group-level Mann-Whitney tests for Rows (a) to (c) and Fisher exact tests for Rows (d) to (f). No significant differences are found between the No-D and No-N treatments, as well as between the Voting-D and Voting-N treatments, in each of the six performance measures ((a) to (f)) – see Appendix Table B.2. [#1] "No voting" includes the No-D and No-N treatments. [#2] "Voting" includes the Voting-D and Voting-N treatments. [#3] The average payoffs in Part 1 are monotonic transformations of the Part 1 average contributions based on Equation (1) for all treatments. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

5.2. Scheme Choice

In contrast to the similar efficiencies in the two voting treatments, however, the popularity of the FS scheme and its vote outcomes differ markedly by the amount of self-regulatory resources. On the one hand, the majority of depleted subjects consistently preferred to use the FS scheme in the Voting-D treatment (Panel A of Figure 3). On the other hand, strikingly, only approximately 30% of non-depleted subjects voted for the FS scheme in the Voting-N treatment. These institutional preferences remained quite stable even after the subjects gained experience. The difference in the vote share for the FS scheme is large: the vote share in the Voting-D treatment is approximately double that in the Voting-N treatment. This voting pattern is indeed consistent with the prediction from the self-control and inequity-averse preference models summarized in Proposition 1.

Table 3 reports the results from the regression analysis of the treatment difference in the subjects' scheme votes. Model 1 of the table includes only the "Depleted" dummy (which equals 1 [0] for the Voting-D [Voting-N] treatment) to identify the treatment difference using all observations. It indicates that the depleted subjects' stronger preference for the FS scheme, relative to that of the non-depleted subjects, is strongly significant. Model 2 includes available demographic variables as additional independent variables to control for possible differences in subjects' individual characteristics. It confirms that the impact of self-regulatory depletion remains significant by almost the same magnitude. Last, Models 3 and 4 add the vote number variable (which equals the phase number minus 1) and its interaction with "Depleted" to evaluate whether the effects of depletion vary as the subjects gain experience. The results show that both the vote number and the interaction are far from significant. This suggests that depleted (non-depleted) subjects' preferences for the FS (IS) scheme persist in the experiment.

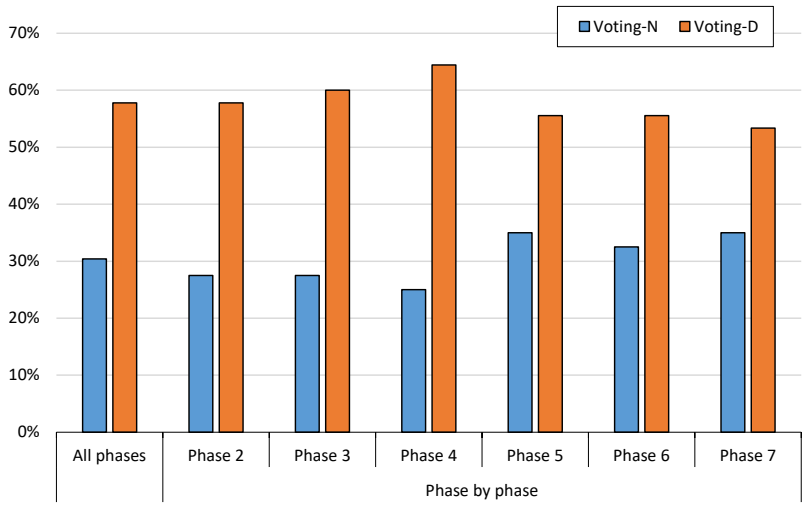
A majority rule was applied in the experiment to determine a group's scheme. Panel B of Figure 3 reports the scheme choice outcomes by treatment. It indicates that the FS scheme was implemented much more frequently in the Voting-D treatment than in the Voting-N treatment. Regression analysis suggests that parallel to the sustained differences in the popularity of sanction schemes (Panel A of Figure 3), the strong effect of self-regulatory resources on voting was not only significant, but it also persisted from phase to phase (Panel B of Figure 3, Models 5 to 8 of Table 3).

It is worth noting here that the difference in the scheme choice outcome (Panel B) is much larger than that in the scheme vote share (Panel A). This is due to the so-called "behavioral public choice theorem"—a key feature of the majority voting rule (e.g., Ertan *et al.*, 2009; Hauser *et al.*, 2014). Under majority voting, minorities tend to be outnumbered by the majority, thus allowing the latter's preference

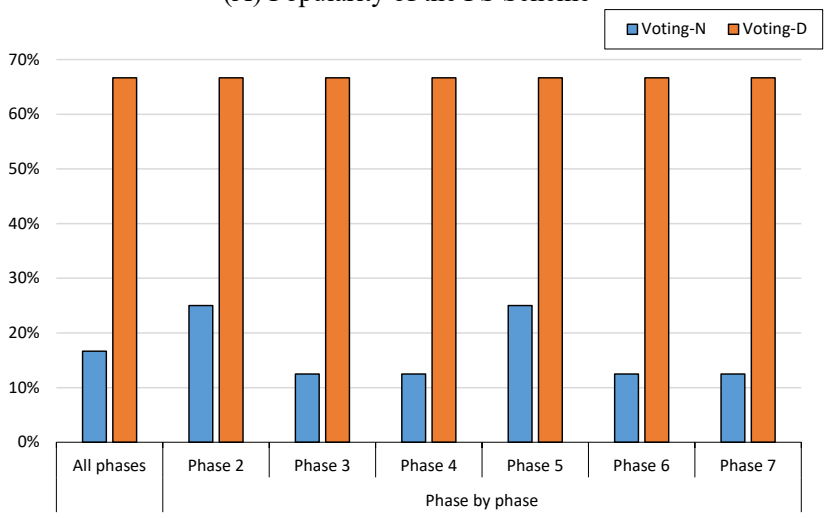
to be more easily enacted in the group.

Result 2: *Consistent with Proposition 1 of Section 4, subjects with smaller amounts of self-regulatory resources relied more on the FS scheme. Strikingly, the vote share of the FS scheme in the Voting-D treatment was approximately double that in the Voting-N treatment.*

Figure 3: *Popularity of the FS Scheme and Vote Outcomes*



(A) Popularity of the FS Scheme



(B) Scheme Choice Outcome (% in Which the FS Scheme was Enacted)

Table 3: *Members' Amounts of Self-Regulatory Resources and Scheme Choices*

Dependent variable:	A dummy that equals 1(0) if Subject *i* voted for the FS (IS) scheme				The vote share of the FS scheme in Group $j \in \{0.0, 0.2, 0.4, 0.6, 0.8, 1.0\}$			
Estimation Method:	Subject random effects probit regressions with robust bootstrapped S.E. clustered by group ID.				Group random effects ordered probit regressions			
Independent variables:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

(a) Depleted dummy {= 1 for the Voting-D treatment; 0 otherwise}	1.322*** (0.401)	1.241** (0.529)	1.787*** (0.664)	1.702** (0.712)	2.013*** (0.761)	2.036** (0.823)	2.937*** (0.925)	2.958*** (0.982)
(b) Vote number variable {= 1, 2, …, 6}	---	---	0.082 (0.074)	0.081 (0.082)	---	---	0.151 (0.096)	0.150 (0.096)
(c) Interaction (a) × (b)	---	---	-0.133 (0.120)	-0.132 (0.125)	---	---	-0.249* (0.131)	-0.248* (0.131)
(d) Constant	-0.968*** (0.289)	-1.065 (0.865)	-1.257*** (0.485)	-1.361 (0.996)	---[#2]	---	---	---
# of observations	510	510	510	510	102	102	102	102
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes
Wald χ^2	10.88	64.33	8.09	78.42	7.00	10.99	10.20	13.89
Prob > Wald χ^2	0.0010	0.0000	0.0443	0.0000	0.0082	0.0515	0.0170	0.0532

Notes: The numbers in parentheses are robust standard errors (S.E.). The units of observations are individuals in Models 1 to 4, and groups in Models 5 to 8. Group-level clustering was included in Models 1 to 4 as each individual's voting may be correlated within their group. Subject random effects linear regressions with robust standard errors (clustered by group ID) generate qualitatively similar results—see Appendix Table B.5.
[#1] The control variables include gender dummies, an economics major dummy, university year dummies, and political preferences in Models 2 and 4 [the percentage of female subjects, the percentage of economics majors, the percentage of the first-year undergraduate students, and the average political preference in a given group in Models 6 and 8]. [#2] The cut points were omitted to conserve space.
*, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

5.3. Performance Differences between the FS and IS Schemes

Both the FS and IS schemes are strong deterrents against free riding, consistent with prior research. Part I of Appendix Table B.4 reports the regression results of examining how formal and informal punishment improved contributions in Part 2 relative to the no scheme condition of the no-voting treatments. It shows that, regardless of the scheme imposed, the average contribution was significantly higher in the Voting-D (Voting-N) treatment than in the No-D (No-N) treatment. The strong effects of sanctioning schemes are not affected by the manipulation of self-regulatory resources (neither the interaction term between the Depleted and FS dummies nor that between the Depleted and IS dummies is significant). This again underlines the robustness of the role of punishment in social dilemmas.

Panel A of Figure 4 reports the contribution dynamics based on whether the sanction rate in the FS scheme is set at a deterrent level. It indicates that once a deterrent sanction rate was collectively enacted, the subjects contributed almost the full endowment, irrespective of the state of their self-regulatory resources.[12] The contribution level was much higher than that under the IS scheme (see Models I and II of Table 4). However, this is not a surprise as full contribution is the unique Nash Equilibrium under the deterrent FS scheme. In contrast to the strong deterrence with high sanction rates, the subjects failed to sustain

[12] Appendix Table B.6 reports a regression analysis to explain subjects' decisions to contribute as a function of the sanction rates enforced. The analysis found that the size of the sanction rate enacted in a group was a significantly positive predictor of the members' contribution amounts.

cooperation when non-deterrent sanction rates were instead enacted (again, see Table 4 and Panel A of Figure 4). While this is also expected, since free riding is clearly the unique Nash Equilibrium outcome with mild sanctions, the contribution levels in the Voting-D treatment were persistently extremely low (the connected dotted lines in Figure 4). This was not the case for the Voting-N treatment, although non-deterrent cases were observed only in Phases 2 and 5 here. The extremely low contribution level with non-deterrent FS suggests that depleted subjects in Voting-D could not resist the temptation to free ride with only mild law. On average, approximately 70% of the subjects voted for deterrent sanction rates in both the Voting-D and Voting-N treatments (Panel C of Figure 4).

One interesting difference was observed between the states of self-regulatory resources: the average contribution under the IS scheme exhibits a significantly increasing trend in the Voting-D treatment. This is in contrast to the trend in the Voting-N treatment, where it remains stable or is somewhat in a decreasing trend (Panel A of Figure 4, Part II of Appendix Table B.4). The same is observed for the subjects' payoffs (Panel B of Figure 4). This difference in the efficiency trend can be explained by the significantly strong pro-social punishment of the depleted subjects in the Voting-D treatment relative to that in the Voting-N treatment (Panel D of Figure 4, Appendix Table B.8). Here, punishment received by Subject i in Period t is classified as pro-social (anti-social) when i's contribution amount $c_{i,t}$ is *less than* (*not less than*) their group's average contribution amount $\overline{c_t}$ in Period t. While pro-social punishment was found to be significantly stronger than anti-social punishment in both the Voting-D and Voting-N treatments (Appendix Table B.9), the punishment activities among the *depleted* subjects were more intense, much more than double those among the non-depleted subjects (Panel D of Figure 4).[13] This feature matters in fostering cooperation norms because those who had been pro-socially punished in Period t increased contribution amounts in Period $t + 1$, *ceteris paribus* (Appendix Table B.10).

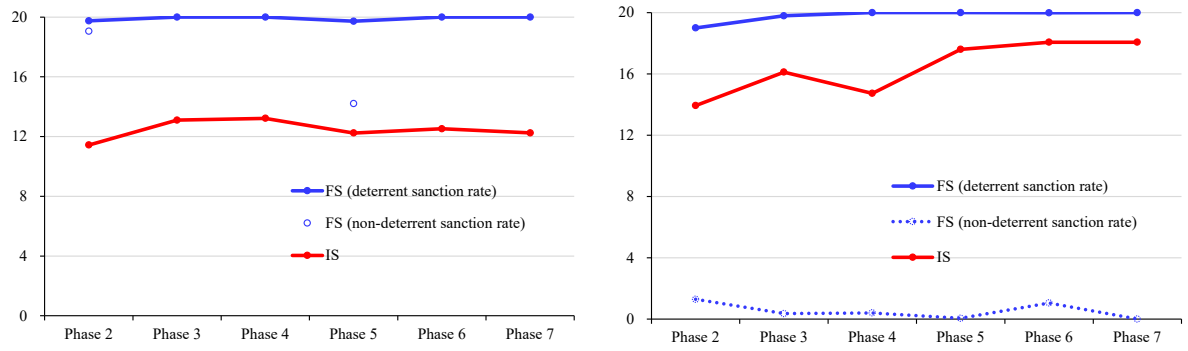
Note that subjects have two conflicting sources of temptation in the punishment stage under the IS scheme: one is to free ride on peers' punishment acts, while the other is to inflict justice driven by negative emotions. The observed punishment patterns suggest that depleted individuals succumbed to the *hot* temptation to respond to their negative emotions, rather than to their *cool* temptation to free ride on others' punishment acts. This interpretation supports the view that (a) punishment decisions may be driven by negative emotional states (e.g., de Quervain *et al.*, 2004), and (b) such motives may be hotter and stronger than their material motives to free ride on others' punishment. There are, of course, many other possible interpretations; however, the bottom line here is that, despite the possibly better effects of the IS scheme in the Voting-D treatment, depleted subjects still preferred to rely on the FS scheme even after gaining experience. The welfare loss due to punishment activities and administrative cost payments was much smaller in the IS scheme than in the FS scheme in a later phase—see Appendix Figure B.2.

Result 3: *(a) Voting on sanction rates and contribution decisions under the FS scheme was similar for the Voting-D and Voting-N treatments. Especially, deterrent FS schemes sustained contributions at almost the full efficiency level. (b) The IS scheme was effective in boosting contributions because pro-social*

[13] These punishment patterns hold for each of the six phases in Part 2 (Appendix Figure B.1).

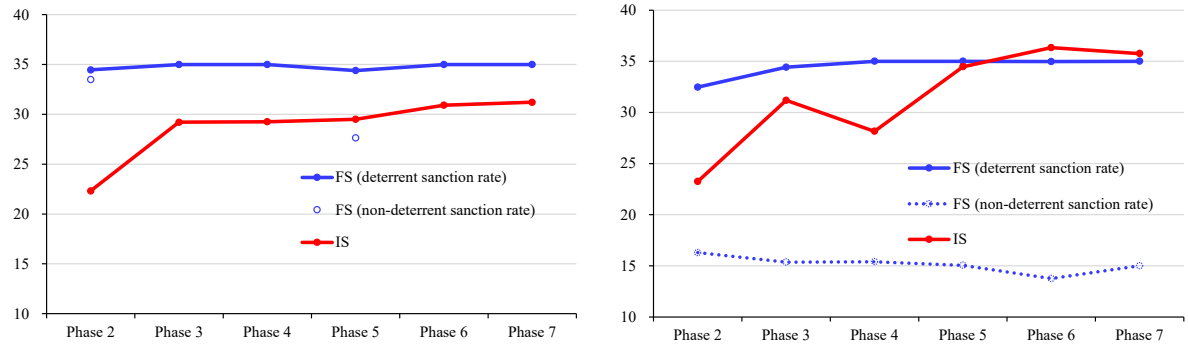
punishment was stronger than anti-social punishment for both voting treatments. Interestingly, pro-social punishment by depleted subjects was significantly stronger than that by non-depleted subjects, and thus depleted subjects more effectively strengthened cooperation norms over time in the IS scheme.

Figure 4: *Performances under Selected Schemes*



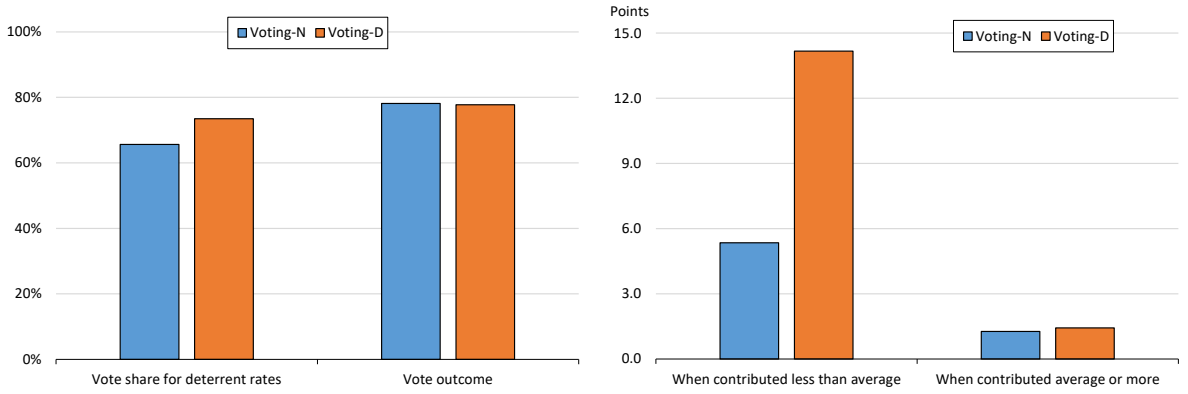
i. Voting-N treatment[#1] ii. Voting-D treatment

A. Average Contribution by Sanction Scheme



i. Voting-N treatment[#1] ii. Voting-D treatment

B. Average Payoff by Sanction Scheme



C. % of Voting on Deterrent Sanction Rates (≥ 0.8) under FS D. Avg. per Period Loss due to Punishment Received under IS[#2]

Notes: [#1] The number of cases in which a group selected the FS scheme was much lower in the Voting-N treatment than in the Voting-D treatment. Non-deterrent rates were enacted only in Phases 2 and 5 in the Voting-N treatment. [#2] See Appendix Figure B.1 for the trend of average loss due to punishment, phase to phase. See Appendix Figure B.2 for the trend of average per subject punishment loss by sanction scheme.

Table 4: *Deterrence of the FS Scheme and Efficiency*

Dependent variable:	Contribution of Subject *i* in Period *t*, where *t* > 4				Payoff of Subject *i* in Period *t*, where *t* > 4			
Independent variables:	I. Voting-D		II. Voting-N		III. Voting-D		IV. Voting-N	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
(a) Deterrent FS dummy	14.688***	14.781***	10.598***	11.066***	10.668***	11.277***	4.556*	3.626
	(1.338)	(1.227)	(2.505)	(2.444)	(1.803)	(1.894)	(2.636)	(2.654)
(b) Non-deterrent FS dummy	-3.504**	-3.477**	7.640***	8.115***	-6.569**	-6.586**	0.167	-0.806
	(1.742)	(1.652)	(2.732)	(2.564)	(2.882)	(2.838)	(2.852)	(2.693)
(c) IS dummy	6.965***	6.989***	8.084***	8.563***	-0.821	-0.856	4.683	3.715
	(2.427)	(2.366)	(2.759)	(2.593)	(4.746)	(4.592)	(2.861)	(2.714)
(d) Constant	6.447***	7.555***	5.225***	6.539***	26.447***	27.236***	25.225***	24.738***
	(1.142)	(1.798)	(1.565)	(2.948)	(1.142)	(2.095)	(1.565)	(3.122)
# of observations	2,160	2,160	2,040	2,040	2,160	2,160	2,040	2,040
Reference Group	No-D	No-D	No-N	No-N	No-D	No-D	No-N	No-N
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.5481	0.5598	0.2726	0.3062	0.2363	0.2626	0.0643	0.1195
Two-sided *p*-values for Wald test:								
H_0: (a) = (b)	0.0000***	0.0000***	0.0025***	0.0018***	0.0000***	0.0000***	0.0039***	0.0030***
H_0: (a) = (c)	0.0001***	0.0001***	0.0058***	0.0040***	0.0085***	0.0054***	0.9414	0.9583
H_0: (b) = (c)	0.0000***	0.0000***	0.1989	0.1836	0.0821*	0.0761*	0.0000***	0.0000***

Notes: Subject random effects linear regressions with robust standard errors (S.E.s) clustered by group ID. The numbers in parentheses are robust S.E.s. Observations from the No-D and Voting-D (No-N and Voting-N) treatments are used for Models I and III (II and IV). [#1] The control variables include gender dummies, an economics major dummy, university year dummies, and political preferences. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

6. Supplementary Opinion Survey

While the laboratory experiment revealed strong effects of people's self-regulatory resources on their policy preferences, one concern is its external validity, as is sometimes the case for a neutrally framed laboratory experiment. To supplement the main laboratory experiment, an opinion survey was additionally conducted regarding people's self-control behaviors and their policy preferences during the recent Covid-19 pandemic. The survey was conducted in July 2022 by recruiting third- and fourth-year undergraduate students at Kansai University.[14] As explained below, it was found that those with weaker self-control were more likely to support the strengthening of the formal enforcement of self-restraint behavior, consistent with the main result from the laboratory experiment.

A challenge in collecting the information of self-control behaviors from respondents is the presence of a possible social desirability bias. Considerable prior experimental research has shown that people are reluctant to accept their socially undesirable behaviors when directly asked in a survey. For

[14] Considering that the survey includes some questions on their behaviors as university students under the government's self-restraint requests, only third- or fourth-year undergraduates (as of July 2022) were recruited. Note that while Japan has declared a state of emergency four times thus far, third- or fourth-year undergraduates experienced all the four self-restraint requests as university students.

example, in the context of an election, respondents are reluctant to accept their vote-buying experiences (e.g., Gonzalez-Ocantos *et al.*, 2012). To avoid such a bias, the respondents were provided with ten concrete examples in the survey, among which seven were on weak self-control behaviors (e.g., "I saw my relatives (and/or your parents if you lived all by yourself), as normal. The frequency of seeing them was not much affected by the declaration of the state of emergency.") and three were on careful and high self-control behaviors (e.g., "I tried avoiding using public transportation (such as trains and buses) as much as possible."); the respondents were then asked to answer, in integers, the question of how many examples applied to their behaviors under the state of emergency (see Appendix C.1.1 for the detail). There are two benefits of using the approach just stated: First, it is possible to let respondents consider more concrete behaviors than when a question asks about their self-control in an abstract manner (e.g., did you comply with almost all the restriction measures imposed in the region?), thereby making it possible to have a more precise measure of their self-control. Second, the ten examples include both socially desirable and undesirable behaviors, whose aspects make it difficult for respondents to immediately notice what indicator the experimenter wants to see from the question. As seven (three) out of the ten examples were on weak (strong) self-restraint behavior, the respondents' answers were expected to range from 3 to 7, such that a larger number would correspond to a weaker self-control type.[15]

The respondents were also asked a different question with ten examples, each of which described how the formal enforcement of restrictions could be strengthened (e.g., "The police should strengthen the patrol duties to monitor people's self-restraint behaviors during the periods when the government's request for self-restraint is in effect."); they were asked how many examples they agreed with—see Appendix C.1.3. The responses are used as the respondents' preferences for strong formal restrictions in the regression analysis.

In addition to these two key variables, the questionnaire asked about the subjects' perceptions of others' self-control (Appendix C.1.2). Not only people's preferences for strong formal restrictions and penalty, but also their own self-control behaviors may be affected by their beliefs about others' behaviors, in which case an omitted variable bias may influence the result. Note that conditional cooperation is quite common in the context of a social dilemma (e.g., Fischbacher *et al.*, 2001; Fischbacher and Gächter, 2010). The questionnaire also asked questions on a variety of respondents' demographic and background information as control variables. These questions are included in Appendix C.1.4.

Appendix Section C.2 summarizes the results of the regression analysis. The results show that those who lack self-control to a larger degree are more likely to support the strengthening of the formal enforcement of restrictions. This significant correlation is not affected by whether people's perceptions of others' self-control or any other control variable are added. The result is also robust to the regression method used—a linear or tobit regression. The supplementary survey therefore confirms, in a realistic context, the key result of a significant relationship between people's self-control types and their

[15] Indeed, most respondents selected numbers between 3 and 7. The percentages of those who selected the numbers 0, 1, 2, 8, 9, and 10 were 0.00%, 3.36%, 8.39%, 2.35%, 0.34%, and 1.01%, respectively.

commitment behaviors that was obtained in the main laboratory experiment.

7. Conclusion

Social dilemmas are ubiquitous in both our private and economic lives, while people's free riding in such dilemmas is known to be harmful to societies and organizations. During the last few decades, economic research has documented that the dilemmas can be overcome when people's incentives are changed by enforcing a formal institution. While a formal institution can effectively alter individuals' material interests such that these are aligned with their group's common interests, enacting it usually entails a cost, such as fixed administrative charges. Thus, the question remains unsettled as to when implementing a formal institution is desirable, as groups can instead use decentralized peer-to-peer monitoring and punishment (e.g., Ostrom, 1990). The present study is the first to show that the need for a centralized solution may depend on the state of the self-regulatory resources of a given group's members. In a novel laboratory experiment that rigorously manipulated their self-regulatory resources, most of the subjects preferred to govern themselves using monitoring and informal punishment when their resources were not depleted. However, when their resources were depleted, the majority of subjects preferred to rely on costly *formal* punishment. A survey on the Covid-19 pandemic revealed a similar relationship: those who had weaker self-control attitudes were more likely to support stronger restriction measures.

This study is closely related to a large research area on self-control and self-regulatory resources. The scheme choice preference found in the experiment is consistent with the well-known self-control model formalized by Gul and Pesendorfer (2001, 2004) when combined with social preferences. The theory suggests that people with *small* amounts of self-regulatory resources incur a *large* self-control cost when they exercise self-control, such that they do not succumb to the temptation to free ride. The presence of disutility causes them to remove such temptations by voting in advance as a commitment device. In contrast, people can easily resist temptation when their resources are abundant. Thus, such strong self-control types sustain cooperation with informal punishment, rather than enact costly formal punishment. The present experiment underlines the presence of such human self-control preferences and the predictive power of the commitment theory in the context of endogenous institutional formation.

While the result obtained from the experiment is sufficiently clear, it is worth emphasizing that the present study is only the first step in exploring the role of self-regulatory resources in an institutional setting. For example, this study adopted experimental parameters frequently used in the literature, such as the group size of five, MPCR of 0.4, and 24-period interactions in Part 2. These settings are desirable and standard, and satisfy the usual requirements for a fixed laboratory size and an experiment duration of approximately two hours. However, there are numerous other possible parameter values, such as different group sizes, in experiments. It is certainly a useful robustness test to study the same question by conducting experiments with different game parameters. For another example, the accuracy of enforcement and noise may affect people's institutional formation. The present study assumes, for simplicity, that not only do the subjects accurately observe their peers' contributions, but that the punishments are also inflicted on the targets as intended. Such perfect observability and the absence of errors are typically assumed in the experimental literature for simplicity (e.g., Falkinger *et al.*, 2000;

Tyran and Feld, 2006; Kosfeld *et al.*, 2009; Putterman *et al.*, 2011; Traulsen *et al.*, 2012; Zhang *et al.*, 2014; Kamei *et at.*, 2015; Fehr and Williams, 2018; Kamei and Tabero, 2021). However, Type I or II errors sometimes occur in a real authority or society. A novel experiment by Nicklisch *et al.* (2016) demonstrated that the imperfect observability of peers' contributions (hence some noise in punishment) raised the attractiveness of formal mechanisms when anti-social decentralized punishment was severe in a group. It can be imagined that self-regulatory resources may be more important for people to behave in such a complex, risky environment; however, how the resource amount affects their institutional choices is unclear. Further experimental research would certainly be useful before the role of self-control is generalized in the context of institutions and social dilemmas.

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Appendix A: Instructions used in the laboratory experiment

Instructions were first written in English as below. Thereafter, Kamei (a native speaker of Japanese) translated them into Japanese. Both the original English version and the translated version (Japanese) can be found in Appendix A.

A.1. Instructions for Part 1

The instructions for Part 1 are the same for all the treatments. The following include the instructions used in this part:

[Original English version:]

Instructions

You are now participating in a decision-making experiment. Depending on your decisions and those of other participants, you can earn money in addition to the 1,000 Japanese yen guaranteed for your participation. Please read the following instructions carefully.

During the experiment, you are not allowed to communicate with other participants. If you have any questions, raise your hand. One of us will come to answer your question.

Your earnings will be calculated in points in the experiment. At the end of the experiment, your points will be converted to Japanese yen at the following rate:

40 points = 90 Japanese yen

At the end of the experiment, your total earnings (including the **1,000 yen** participation fee) will be paid out to you in cash. Your payment will be rounded to the nearest 50 yen (e.g., ¥2,450 if it is ¥2,444, and ¥2,400 if it is ¥2,424).

At the beginning of the experiment, you are randomly assigned to a group of five and interact with one another. **You will be part of the same group throughout the entire experiment**. This experiment consists of two parts. Part 1 comprises four periods, while Part 2 has six phases, each comprising four periods (in total, 24 periods for Part 2). Thus, there are seven phases (a total of 28 periods) in the experiment. Please click the submit/continue button of each screen once you make decision.

We will first explain the details of Part 1. We will distribute the instructions for Part 2 once Part 1 is over.

PART 1

Your decision in each period:

In each period, you and your four group members are each given **an endowment of 20 points** and must simultaneously make allocation decisions. There are two accounts to which points can be allocated: the **private and group accounts**. Specifically, you are asked how many points you want to allocate to the group account. The remaining points (that is, 20 minus your allocation to the group account) will automatically be allocated to your private account. Your earnings in a given period depend on **(a) the number of points in your private account and (b) the total amount allocated to the group account**.

How to calculate your earnings:

Your earnings in a given period are calculated according to the following formula:

(sum of points in your private account) + 0.4 × (sum of points allocated by you and your group members to the group account)

In other words, your earnings from your private account **are equal to the number of points you allocated to the private account** (20 minus your allocation to your group account). The points that you allocate to your private account do not affect your group members' earnings.

By contrast, your earnings from the group account equal the **sum** of the points allocated to the group account by you and your four group members multiplied **by 0.4**. In other words, if you allocate 1 point to the group account, your earnings from your allocation is $0.4 \times 1 = 0.4$ points, which is less than 1 point. However, by allocating 1 point to the group account, each of your group members' earnings also increase by 0.4 points. Therefore, the total earnings in this case are 2.0 ($= 0.4 \times 5$) points, which is greater than 1 point. Note that you also obtain earnings of 0.4 points for each point your other group members allocate to your group account.

Once all group members make allocation decisions, you will be informed of the interaction outcomes (your earnings, along with each of the four group members' allocation decisions, anonymously and randomly).

If you have any questions, please raise your hand. When all questions are answered, we will move on to comprehension questions.

Comprehension questions

Please answer the following questions. Raise your hand if you need any help.

1. Suppose that all five members in your group allocate 0 points to the group account. How much does each member earn? _____

2. Suppose that all five members in your group allocate 20 points to the group account. How much does each member earn? _____

3. Suppose that the other four members in your group, in total, allocate 15 points to the group. Answer the following:

a) How much do you earn if you allocate 0 points to the group account? _____

b) How much do you earn if you allocate 10 points to the group account? _____

c) How much do you earn if you allocate 20 points to the group account? _____

Are there any questions? When all questions are answered, we will move on to Part 1.

[Translated version (Japanese):]

実験にようこそ

予定通り意思決定実験を始めます。実験参加費の１,０００円に加え、実験での自身の意思決定と他の参加者の意思決定に応じた報酬を受け取ることが出来ます。

実験中に他の参加者と会話をすることは認められません。質問がある場合は手をあげてください。質問は個別にお答えします。

実験での他の参加者との交流によりポイントを獲得することが出来ます。実験終了とともにあなたのポイント総額は日本円で以下のレートで換算され現金で支払われます。

４０ポイント＝９０円

あなたの対価は最も近い５０円の単位で支払われます。例えば総額が２,４４４円の場合は２,４５０円が、例えば総額が２,４２４円の場合は２,４００円が支払われます。

実験の開始とともにあなたはランダムに５人からなるグループに割り振られグループ内で他の実験参加者と交流します。**グループ構成は実験を通じて同じであり変わることはありません。**

本実験は２つのパートから成り立ちます。第１パート（第１フェーズ）は４つのラウンドから構成され、第２パートは６つのフェーズから成り立ちます（各フェーズには４ラウンドあるため、第２パートは合計２４ラウンドあります）。従って本実験には、合計７フェーズ（計２８ラウンド）があります。各スクリーンには「Continue」「OK」等のボタンがありますので意思決定をしたらボタンを押して次に進んでください。

まず、パート１の詳細を説明します。パート２についてはパート１終了後説明します。

パート１

各ラウンドにおけるあなたの意思決定

毎ラウンド、あなたとその他４人のグループ構成員はそれぞれ**２０ポイントの財産**が与えられ、『**個人会計**』と『**グループ会計**』にどのように配分するか意思決定をします。配分の意思決定は５人同時に行います。具体的には何ポイントをグループ会計に配分するか聞かれます（グループ会計に配分しなかったポイントは自動的に個人会計に配分されます）。当該ラウンドにおけるあなたの獲得ポイントは（a）個人会計にあるポイント数と（b）グループ会計にあ

る総ポイント数によって決まります。

各ラウンドにおける獲得ポイントの計算方法

当該ラウンドにおけるあなたの獲得ポイントは次の式によって計算されます。

（あなたの個人会計にあるポイント数）＋０.４×（あなた及び他の４人の構成員によるグループへの配分額の合計）

すなわち、個人会計からのあなたの利得は自身の個人会計に配分されたポイント数になります。あなたの個人会計への配分が他のグループ構成員の利得に与える影響はありません。

一方で、あなたのグループ会計からの利得はあなたを含めた５人の構成員による**配分額の合計に０.４を乗じた値**になります。つまり、あなたが１ポイントをグループ会計に配分すると、あなた自身は１ポイントよりも小さい０.４ポイントを獲得することになりますが、同時に他の４人の構成員もそれぞれ０.４のポイントを獲得します。従ってグループ内における総ポイント獲得数は１ポイントよりも大きい２ポイント（＝０.４×５）になります。同様に、他のグループ構成員が１ポイントを配分するたびにあなたは０.４ポイントを獲得することが出来ます。

グループ構成員５人全てが配分に関する意思決定をした後、あなたのグループにおける配分問題の結果を知らされます。具体的には、当該ラウンドにおける自身の獲得ポイント数と、他構成員４人のグループ会計への配分ポイントが匿名でランダムの順で表示され知らされます。

質問があれば手をあげてください。全ての質問に答えたうえで確認問題に移ります。

確認問題

次の問題に答えてください。質問等があれば個別に答えますので手をあげてください。

１.あなたのグループの５人全員がグループ会計に０ポイント配分したと仮定してください。この場合、各メンバーは何ポイントを獲得しますか？　＿＿＿＿＿＿＿＿

２.あなたのグループの５人全員がそれぞれ２０ポイントをグループ会計に配分したと仮定してください。この場合、各メンバーは何ポイントを獲得しますか？＿＿＿＿＿＿＿＿

３.あなた以外の４人によるグループ会計への合計配分額が１５ポイントであると仮定してください。 次の質問に答えてください。

a) あなたのグループ会計への配分が０ポイントの場合、あなたの獲得ポイントはいくらですか？ _____

b) あなたのグループ会計への配分が１０ポイントの場合、あなたの獲得ポイントはいくらですか？ _____

c) あなたのグループ会計への配分が２０ポイントの場合、あなたの獲得ポイントはいくらですか？ _____

質問はありますか？全ての質問に答えた後でパート１を始めます。

A.2. Instructions for Part 2

The following includes the instructions for the No-D and Voting-N treatments as an example.

(a) No-D treatment

[Original English version:]

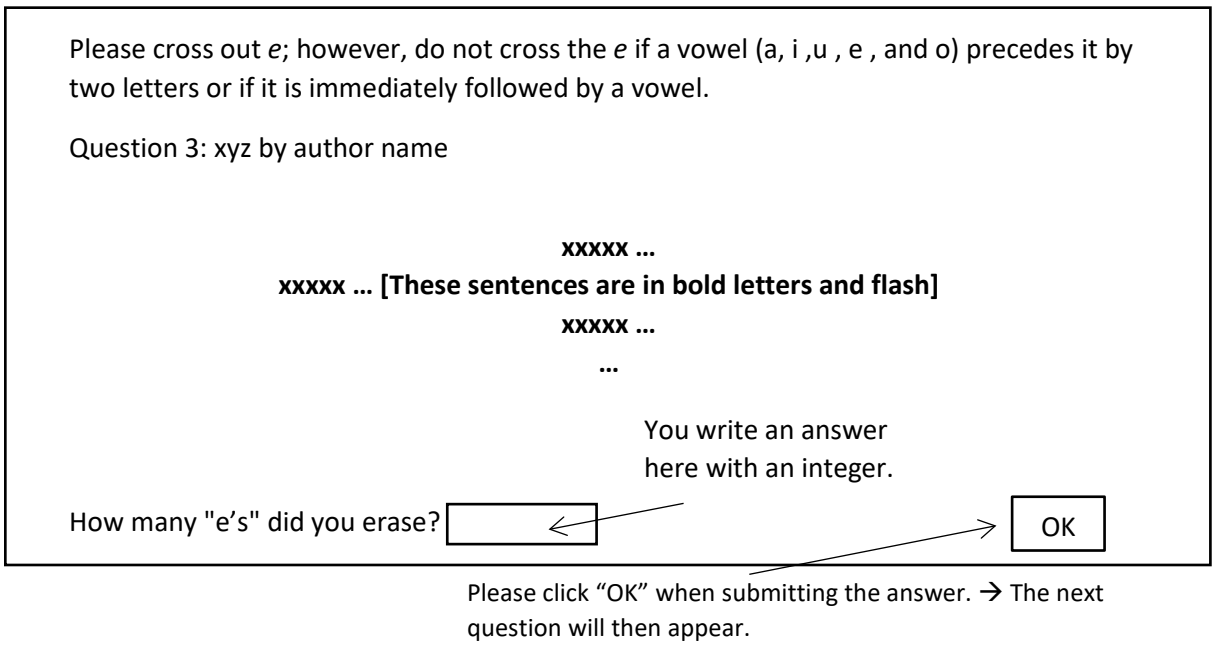
Instructions for Part 2

As explained, you have **six** phases, each comprising four periods (in total, 24 periods), in Part 2.

You will continue to interact with the same four individuals. In each period, you will decide on allocating 20 points to either a private account or a group account, with the same immediate payment consequence (see the instructions for Part 1). The conversion rate is the same: 40 points = 90 Japanese yen.

Before the six phases of the interactions, you have another task. You will be allocated eight minutes **to cross out *e*, except when a vowel precedes it by two letters or it is immediately followed by a vowel**. This task is called the "crossing-out task." For example, if you see the word "tree," then you will cross the second *e* (i.e., tre<u>e</u>) but not the first one (i.e., tr<u>e</u>e). If you see the word "however," then you will not erase the first *e* (i.e., how<u>e</u>ver) since the vowel *o* precedes it by two letters. You will also not erase the second *e* (i.e., howev<u>e</u>r) since the vowel *e* precedes it by two letters.

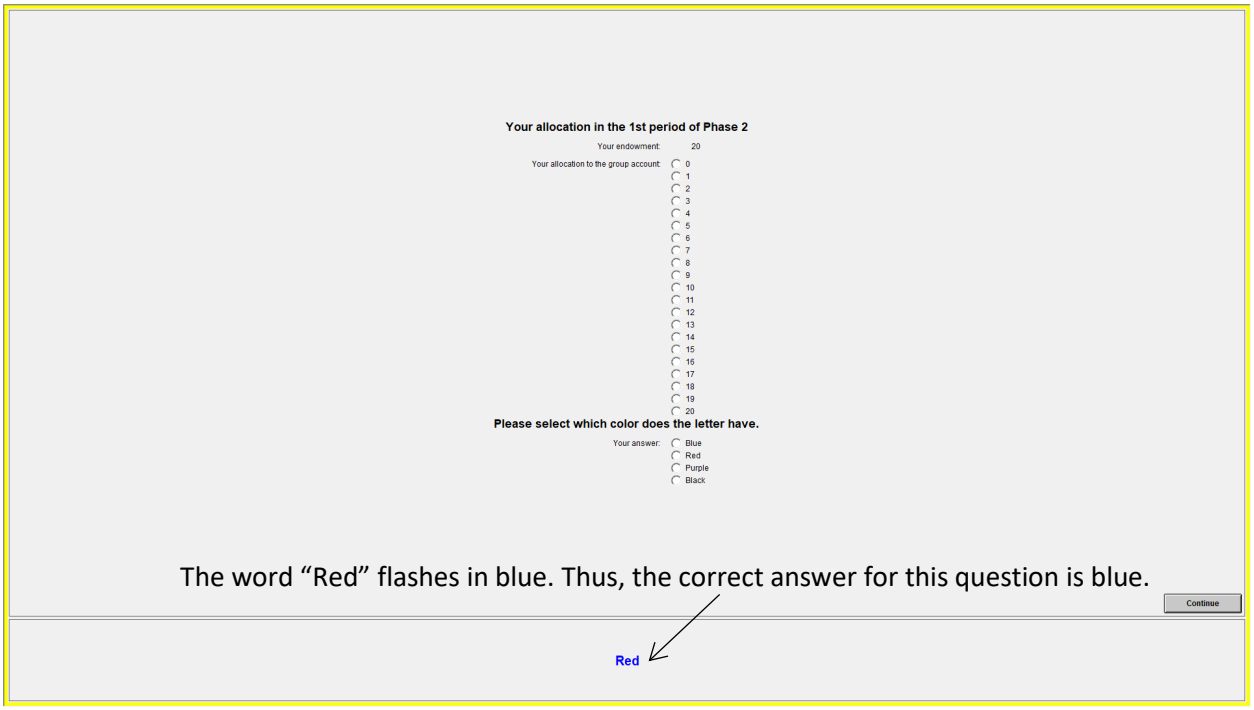
During the eight minutes, you will be given up to six questions from well-known English books. For each question, you will be asked how many *e*'s you erased for the sentences provided. The computer screen image is as below:



For each correct answer, you earn 1 point. Thus, the maximum points you can earn from this task is 6 points.

An additional task in each period of Part 2:

In the allocation decision stage of each period, you will have another opportunity to earn points. The following is a computer screen image of a period in Part 2. In the bottom part of the screen, one word will flash either in blue, red, purple or black. You will be asked the color of the word. For example, the word "Red" flashes in blue in the screen below. Thus, the answer is blue, although the word itself is red.



For each correct response to the color question, you will earn 1 point. Since there are a total of 24 periods in Part 2, you can earn up to 24 points from this task.

Are there any questions? When all questions are answered, we will move on to the Part 2 of the experiment.

[Translated version (Japanese):]

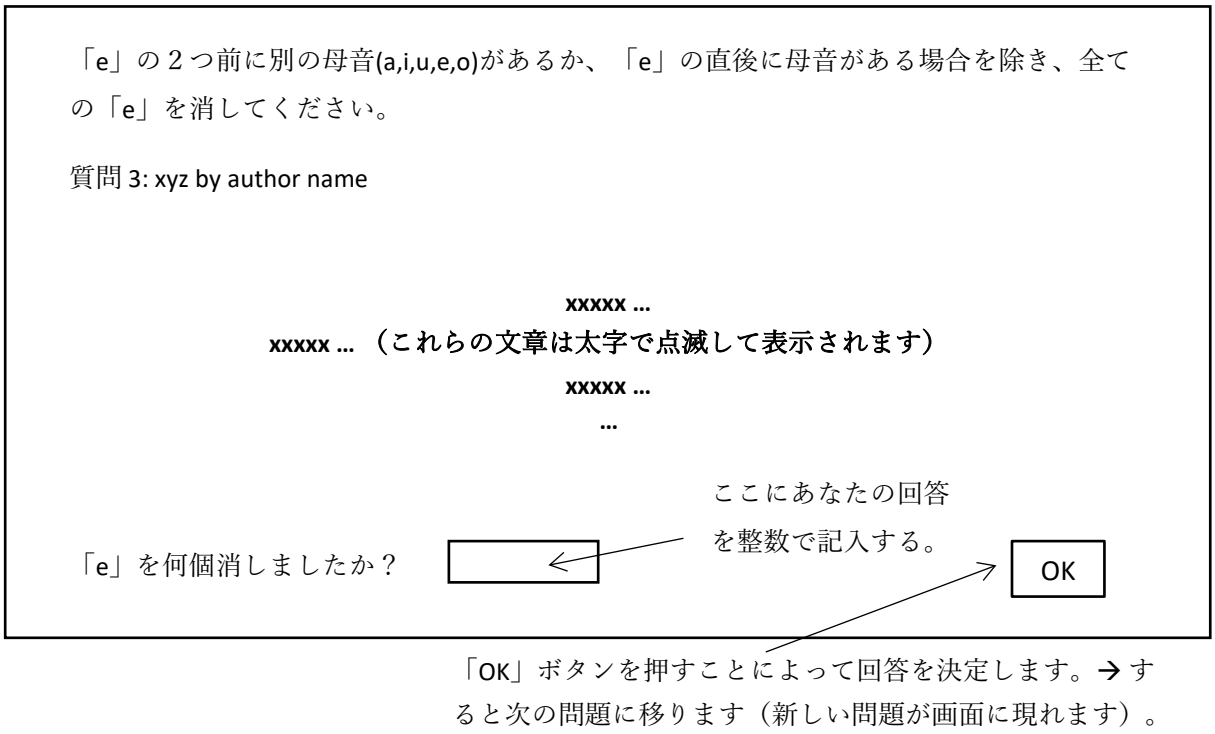
パート２

既に説明したように、パート２は**６つの**フェーズ（各フェーズ４ラウンド）から構成されます。従って合計２４ラウンドあります。

あなたは引き続き同じ４人のグループ構成員と交流を続けます。あなたは毎ラウンド、２０ポイントの財産が与えられ、それを個人会計とグループ会計の間でどのように配分するか意思決定をします。獲得ポイントの計算方法はパート１と同じです。ポイントと日本円の換算率も同一です（４０ポイント＝９０円）。

配分問題の意思決定に移る前に、別のタスクがあります。英語の文章が与えられ、「e」の２つ前に別の母音(a,i,u,e,o)があるか、「e」の直後に母音がある場合を除き、全ての「e」を消すことでポイントを得ることが出来るタスクです。タスクは８分間継続します。このタスクは『「e」を消すタスク』と呼ばれます。例えば、tree という字があったと想定してください。この場合、二つ目の「e」(即ち tr**e**e) は消す一方で一つ目の「e」(即ち tr**e**e)は消しません。その他の例として however という字があったとします。この場合は母音の「o」が２つ前にあるため一つ目の「e」(つまり how**e**ver) は消しません。また、母音の「e」が２つ前にあるため二つ目の「e」(つまり howev**e**r)についても消しません。

８分間の間、合計６つまで質問を解くことが出来ます。各問題は著名な本からです。各問題で、「e」を何個消したかを答える形になります。実際のコンピュータ画面のイメージは以下のようになります。

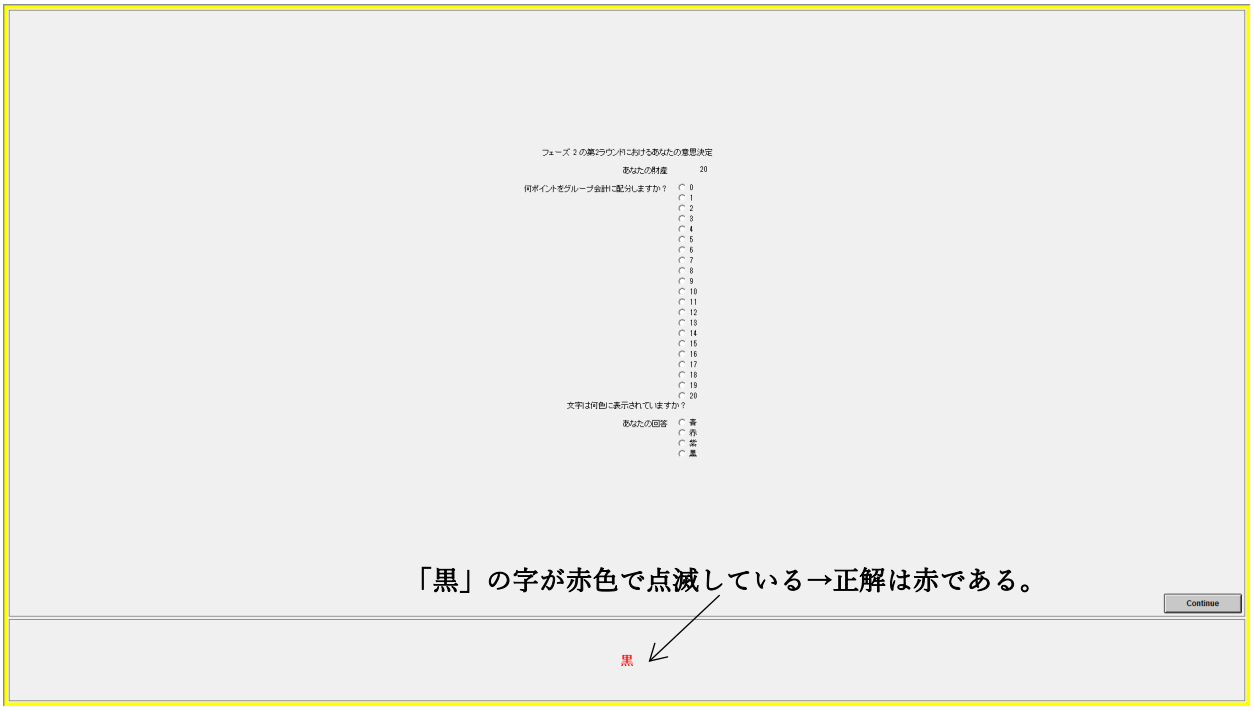


正解１問につき１ポイントを獲得できます。合計６問ありますので、合計６ポイントまで獲得できます。

パート２の配分問題ラウンドにおける追加タスク

「e」を消すタスク終了後、財産の配分を通じたグループ内での交流に移ります。

毎ラウンド、追加で１ポイントを獲得する機会があります。つまり、各ラウンドで財産の配分の意思決定をするスクリーンで別のタスクがあります。以下の画面はパート２の各ラウンドで実際に見るコンピュータ画面の例になります。配分問題の下部に字が青色、赤色、紫色、または黒色で表示されます。これに対し、字が何色で映っているかを聞かれます。例えば下の画面では「黒」の字が赤色で点滅しています。従って、字の意味は黒であるが、この問いに関する正解は赤となります。



色を答える問題に正解するごとに追加で１ポイントを獲得することが出来ます。パート２には合計２４ラウンドあることから、合計２４ポイントまでこのタスクから獲得することが出来ます。

質問があれば手をあげてください。全ての質問に答えた後、パート２を開始します。

(b) Voting-N treatment

[Original English version:]

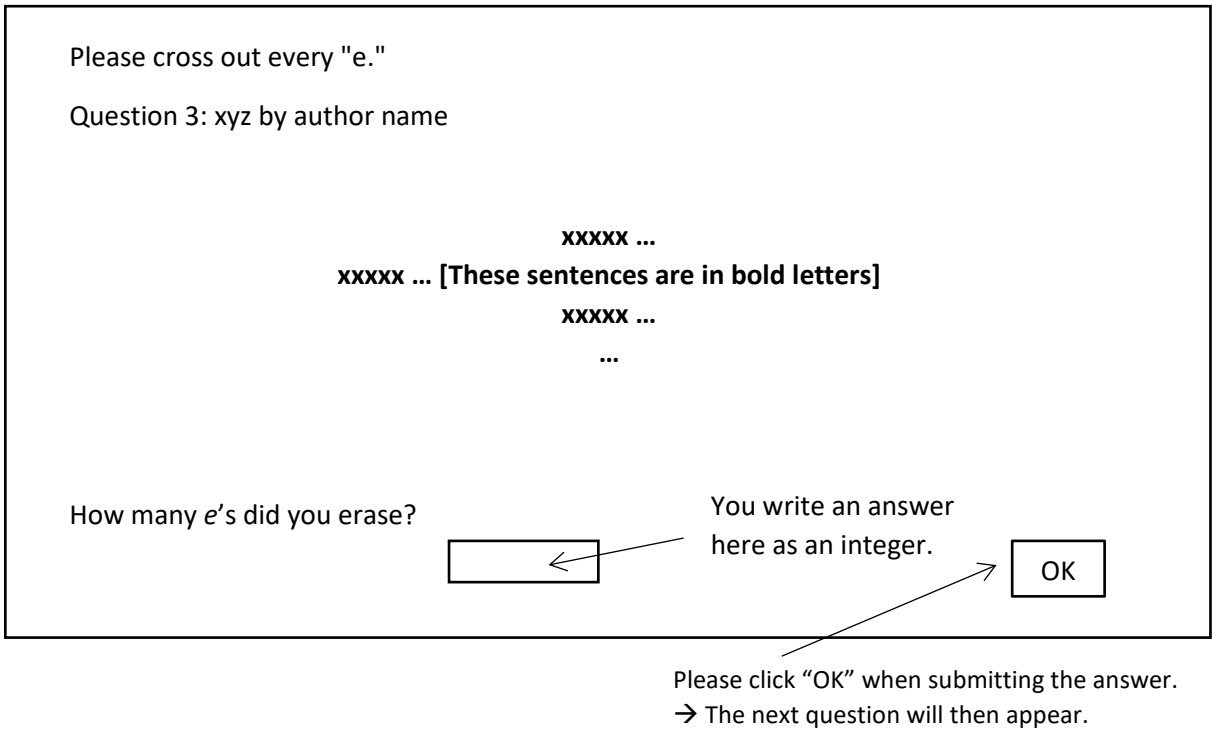
Instructions for Part 2

As explained, you have **six** phases, each comprising four periods (in total, 24 periods), in Part 2.

You will continue to interact with the same four individuals. In each period, you will decide on allocating 20 points to either a private account or a group account, with the same immediate payment consequence (see the instructions for Part 1). The conversion rate is the same: 40 points = 90 Japanese yen.

However, there is a difference from the interactions in Part 1, which will be explained later. Before moving to the six phases of the interactions, you have another task. You will be allocated eight minutes **to cross out every *e*.** This task is called the "crossing-out task." For example, if you see the word "tree," then you will cross out two *e*'s (i.e., tr*e*e). If you see the word "however," then you will erase both the first (i.e., how*e*ver) and second (i.e., howev*e*r) *e*'s.

During the eight minutes, you will be allocated up to six questions from well-known English books. For each question, you will be asked how many *e*'s you erased for the sentences provided. The computer screen image is as below:



For each correct answer, you earn 1 point. Thus, the maximum points you can earn from this task is 6 points.

Are there any questions? Once all questions are answered, we will explain the details of the six phases in Part 2.

The six phases of the interactions

Once everyone completes the crossing-out task, you will interact with your group members in Part 2.

There is a significant difference in that each period comprises two stages. In the first stage, you make your allocation decision and learn the other group members' decisions, along with your earnings. In the second stage, your earnings from the allocation stage can be reduced. There are two possible schemes governing the second stage of each period. **At the beginning of each phase, your group will determine, by majority vote, which of the two schemes will be used during the four periods of that phase.** You can select different schemes in different phases.

In one of the two possible schemes, the group votes on the rules of a fine (which we call "**Group-determined fines**"); in the other, individuals can reduce others' earnings after learning of their allocations (which we call "**Individual reduction decisions**").

Scheme 1: Group-determined fines

In this scheme, earnings from the allocation stage can be reduced by a fine rule. When a rule is in place, allocations to the **private** account are subject to a fine.

At the beginning of each period, your group chooses a fine rate (the amount of the fine per point allocated to the private account) by voting. Possible fine rates are 0.0, 0.4, 0.8, and 1.2 points per point allocated to the private account.

Variable cost: For each point that is lost by a member who is fined, the group also incurs a cost of **5/11 points (approximately 0.45 points)** to impose that fine. This cost is interpreted as the **administrative cost** of imposing the fine. All group members (including the fine recipient) equally share the cost. Specifically, for each 1 point in fines imposed on any group member, each group member pays (1/5)*(5/11) = **1/11 points** as their per capita cost of imposing the fine. Note that since the person fined loses a total of 1+1/11 =12/11 points while the other four group members pay a total of 4/11 points in the aggregate (i.e., 4×1/11) in imposing the fine, **the ultimate cost ratio is 3:1 (= 12/11: 4/11)**.

Fixed charge: In addition to the fines and costs based on the fine rule your group chooses, at the end of a period, a fixed cost of **5 points** is deducted from each group member's earnings. This can be thought of as the fixed administrative cost of having a fine scheme in operation, a cost that does not depend on how frequently fines are imposed.

Fines in the current phase cannot reduce an individual's earnings for a period to less than zero. However, you always incur the per capita share of the cost of imposing fines and the fixed charge, even if it reduces your earnings for the period to less than zero.

This means that your earnings for a period can be calculated as follows:

Part A: Earnings from the allocation stage minus your fine, or 0 if it is negative

minus

Part B: Your share of the cost of administering the fine scheme
= your per capita share of imposing the fine + 5

As mentioned, you incur the cost of Part B even if it causes your net earnings for the period to be negative.

The fine rate in a given period will be determined based on **the median** of the five votes casted by group members. For example, if five members enter choices of 0.4, 0, 0.4, 1.2, and 1.2 as their preferred rates, then the fine rate will be 0.4 for that group.

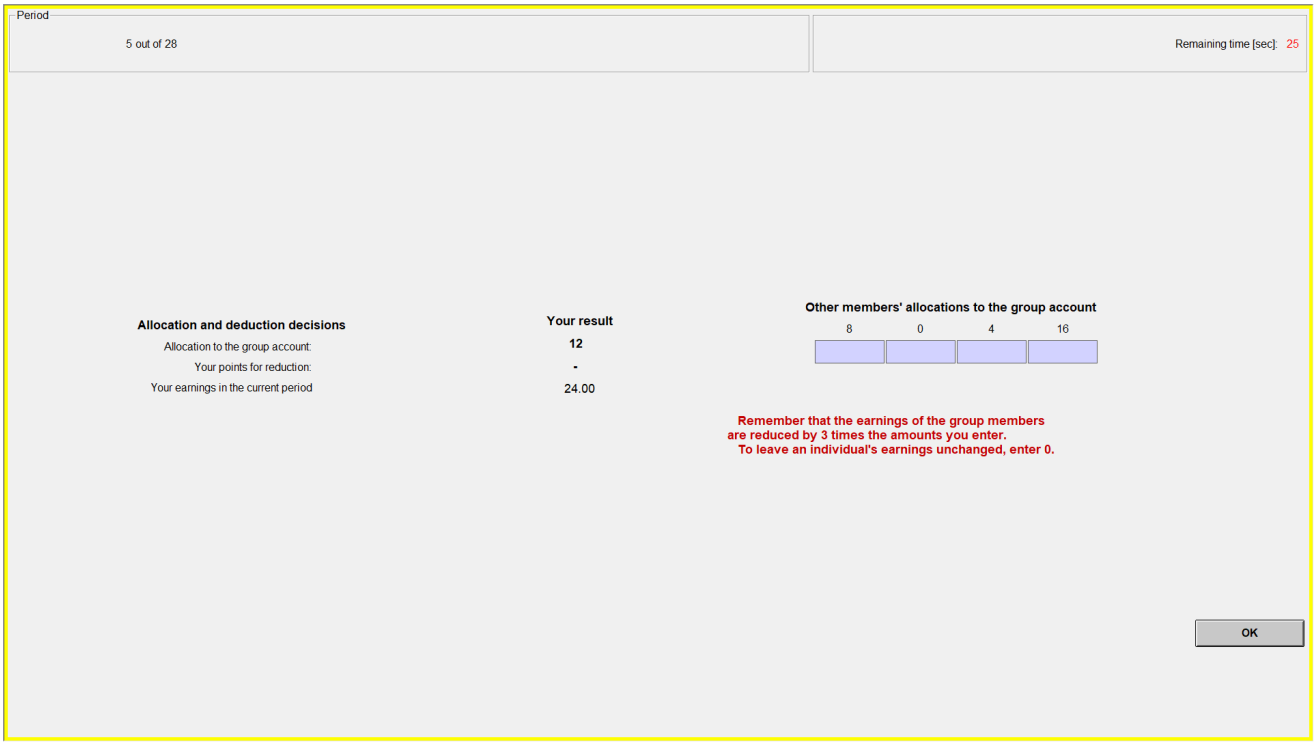
Note that there is effectively no fine if your group chooses a fine rate of 0. Also, even if the fine rate is positive, earnings at the end of a period may be unchanged from those at the end of the allocation stage if no member allocates points to the private account (you must still pay a fixed administrative charge of 5 points in this case).

Summary: In each period of this phase, your group will first vote on the fine rate. You will be informed of the vote outcome, and will then decide how to allocate between your private and group accounts.

<u>Scheme 2</u>: Individual reduction decisions

In this scheme, you have an opportunity, in Stage 2 of each period, to reduce the earnings of others in your group at a cost to your own earnings. You can assign "reduction points" to each of your group members.

Each reduction point you allocate to reducing another's earnings <u>reduces your own earnings by 1 point and reduces that individual's earnings by 3 points</u>. Thus, the **cost ratio is 3:1**, as in the group-determined fines explained above. Your own earnings can similarly be reduced by the decisions of the four other members in your group. You are free to leave any or all others' earnings unchanged by entering 0's in the relevant boxes.



Note: Numbers are for illustration only

Earnings reductions directed at you cannot reduce your earnings for the period to less than zero. However, you always incur the cost of assigning reductions to others even if it makes your period earnings negative. (If you lose points in a period, they are deducted from those you accumulate in other periods.) Thus, your earnings in each period of this phase can be calculated as follows:

<u>Part A</u>: Earnings from the allocation stage minus reductions by others in your group, or 0 if it is negative

minus

<u>Part B</u>: Points that you use to reduce others' earnings

Note that you incur the cost in Part B even if it causes your net earnings for the period to be negative.

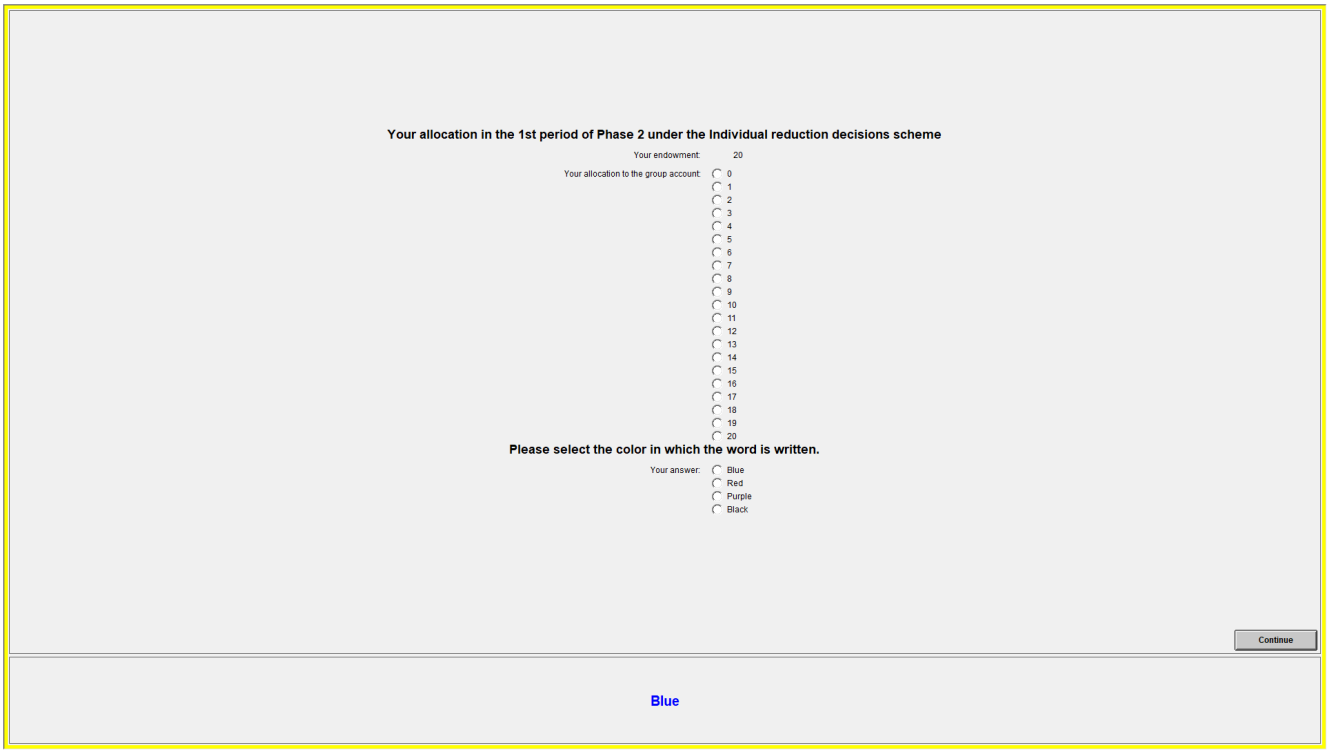
In addition to the fact that earnings from the allocation stage and reductions received cannot fall below zero (see the equation in Part A above), the earnings reduction process is subject to two requirements. First, your reduction points must be an integer. Second, you cannot assign more than 10 reduction points to any one individual in your group.

Remember that if no reductions are imposed (the reduction boxes are filled in with 0's), the earnings after the reduction stage are the same as those before it.

An additional task in the allocation stage in each period of Part 2:

In the allocation decision stage of each period, you will have another opportunity to earn points. The following is a computer screen image of a period in Part 2. In the bottom part of the screen, one word will appear either in blue, red, purple, or black. You will be asked the color of the word. For example, the word "Blue" appears in blue in the screen below. This means that the answer is blue. Please note that **the meaning of the word (blue in this case) is always the same as the color of the word on the screen.**

For each correct response to the color question, you will earn 1 point. Since there are a total of 24 periods in Part 2, you can earn up to 24 points from this task.



Note: Numbers are for illustration only

Summary of Part 2 (phases 2 to 7):

Part 2 begins with the crossing-out task for eight minutes, whereafter you will move to the six phases of interactions.

At the beginning of the first period in every 4-period phase, you will vote on two schemes: "group-determined fines" versus "individual reduction decisions."

Whichever scheme obtains the most votes (≥ 3 votes) will be in effect for four periods.

(i) When "group-determined fines" is chosen:

In each period, you will vote on the fine rate. The median of the five votes in your group is used for the fine rate. Under the chosen fine rate, you and your group members simultaneously decide allocations between your private and group accounts. Note that you have four voting opportunities as there are four periods in the phase.

(ii) When "individual reduction decisions" is chosen:

In each period, you will make your decision on allocating points to your private or group account. Thereafter, you will be informed of how much each of the other members allocated to the group account; you will then decide on whether to reduce their earnings, and by what amount if you do.

You will vote **6 times,** in total, on the scheme to be used by your group—once for each of Phases 2 – 7.

Comprehension questions:

Please answer the following questions. Raise your hand if you need help.

1. About voting between the two schemes:

a) How many periods do you have in Part 2 of the experiment? _____

b) How many times do you have an opportunity to vote on which scheme is used?

_____

c) If your group selects the group-determined fines scheme in Phase 3 (Periods 9 – 12), can it select a different scheme in Phase 4 (Periods 13 – 16)?

_____

2. Suppose that the group-determined fines scheme is in effect in a given phase.

a) What is the fixed charge per period for operating the fine scheme? _____

b) Suppose that the five votes on fine rate in your group are 0.4, 0.8, 0, 0.8, and 1.2. What is the fine per point in your group? _____

c) Suppose that your group selected a fine rate of 0.4, and that you allocate 15 points to the group account. How many points will you lose in the form of a fine*? _____ points
* Note: do not include your share of the cost of imposing this fine in your answer.

What will be your share of the cost of imposing that fine? _____ points (Each of the other four members also incurs this fee.)

3. Suppose that the individual reduction decisions scheme is in effect in Phase 3.

How much does it cost you to reduce another group member's earnings by 6 points in Period 10?
_____ points

[Translated version (Japanese):]

パート２

既に説明したように、パート２は**６つの**フェーズ（各フェーズ４ラウンド）から構成されます。従って合計２４ラウンドあります。

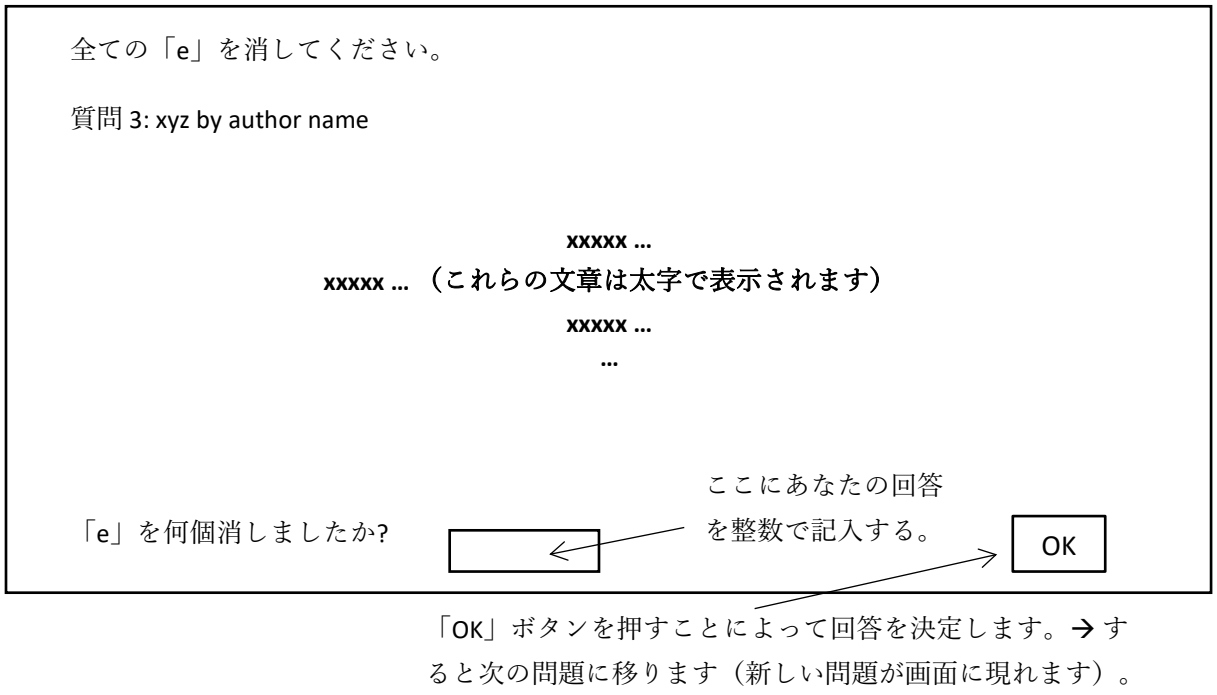
あなたは引き続き同じ４人のグループ構成員と交流を続けます。あなたは毎ラウンド、２０ポイントの財産が与えられ、それを個人会計とグループ会計の間でどのように配分するか意思決定をします。獲得ポイントの計算方法はパート１と同じです。ポイントと日本円の換算率も同一です（４０ポイント＝９０円）。しかしながら、配分問題は、後述する通り、パート１と違う部分があります。

配分問題の意思決定に移る前に、別のタスクがあります。英語の文章が与えられ、全ての「e」を消すことでポイントを得ることが出来るタスクです。タスクは８分間継続します。このタスクは『「e」を消すタスク』と呼ばれます。例えば、tree という言葉があったと想定してください。この場合、「e」を２つ消します。その他の例として however という言葉があったとします。この場合も 「e」を２つ消すことになります。

８分間の間、合計６つまで問題を解くことが出来ます。各問題は著名な本からです。各問題で、「e」を何個消したかを答えてください。実際のコンピュータ画面のイメージは以下のようになります。

正解１問につき１ポイントを獲得できます。合計６問ありますので、合計６ポイントまで獲得できます。

質問があれば手をあげてください。全ての質問に答えた後、配分問題の説明をします。



パート２の６つのフェーズの配分問題

全ての参加者が「e」を消すタスクを終えた後、パート２の配分問題が始まります。

パート１とは異なり、各ラウンドには『グループ罰則ルール』か『個人罰則ルール』が遂行されます。『グループ罰則ルール』では、配分の意思決定前に、個人会計に配分したポイントに科される罰則のルールを**投票で**決めます。『個人罰則ルール』では、配分の意思決定をした後で（他の４人の構成員の配分の決定を見た後で）各構成員がそれぞれどのように他の構成員の利得を減らすかを決めます。 **各フェーズの開始とともに、同フェーズの４つのラウンドで使用するスキームを多数決で決定します。**スキームの決定はフェーズ毎行うため、フェーズで違うスキームを選んでも構いません。

スキーム１: グループ罰則ルール

このスキームのもとでは、各ラウンドの配分問題の前にグループ内で罰則ルールを投票で構築します。このルールは個人会計に配分されたポイントに対する罰則です。 具体的には、罰則率（個人会計に１ポイント配分されるたびに課される罰則）を０.０、０.４、０.８、１.２の中から１つ決定します。５人により投票された罰則率の**中央値（ミディアン）**があなたのグループで使用されます。例えば、５人が投票した率が０.４、０.０、０.４、１.２、１.２の場合は０.４がグループの罰則率として遂行されます。

例えば、適用される罰則率が０.４の時に、あるメンバーが５ポイントを個人会計に配分した場合、このメンバーは２（=０.４×５）ポイントの罰則を受け、利得が２ポイント低減します。

変動型運営費：罰則により損失したポイントの**１１分の５**を、同罰則を科す費用としてグループが負います。この費用は罰則を科す**運営費**です。各構成員は（罰則を受けたメンバーを含め）平等にこの運営費の５分の１、即ち、損失ポイントの**１１分の１**（＝11/5×1/5）を支払います。従って、下の表が示す通り、（a）罰則を受けたメンバーが負うコストと（b）他４人の構成員が負うコストの合計の比は**３：１（＝１２/１１：４/１１）**となります。

	罰則による損失	運営費の分担	利得減少額合計
Ｙポイントの罰則を受けたメンバーが被る利得低減額	Ｙポイント	Y/11 ポイント	12Y/11 ポイント
他４人の構成員が負うコストの合計	０ポイント	Y/11×4 ポイント	4Y/11 ポイント

固定費用：グループ罰則ルールでは（罰則による損失と運営費に加え）各構成員は毎ラウンド**５ポイント**の固定費用を支払うことが要求されます。この費用は罰則スキームを運営する固定管理費用です。この費用は罰則が遂行される頻度に関わらず発生します。

あなたが受けた罰則による損失のために当該ラウンドの利得が負になることはありません。しかしながら、罰則を科す費用分担と固定管理費用（５ポイント）は常に発生します。従って、当該ラウンドにおける利得が負になる可能性もあります。

当該ラウンドにおけるあなたの利得は以下の式により表されます。

式：Part A － Part B

Part A: 配分ステージの利得から受けた罰則を差し引いた総ポイント数（値が負の場合は０）

Part B: 罰則スキームを管理・運営する費用＝罰則を科すために支払う費用分担＋５

注釈：仮に罰則率として０.０が遂行された場合は実質的に罰則はありません（パート１と同じ設定になります）。

また、正の罰則率が選ばれた場合でも、グループの５人全てが２０ポイントをグループ会計に配分すれば誰も罰則による損失を被ることもありませんし、従って罰則遂行のための変動運営費用を負うこともありません（一方で固定費用の５ポイントはこの場合でも発生します）。

スキーム２: 個人罰則ルール

このスキームでは、毎ラウンド、配分問題の後で４人それぞれの利得を減らす機会が与えられます。具体的には他の構成員それぞれに「削減ポイント」を割り振ることが出来ます。

他の構成員に割り当てた削減ポイント１ポイントあたり、あなたは１ポイントを支払う必要がありますが、削減ポイントを割り当てられたメンバーは利得を３ポイント減らします。従って、グループ罰則ルールと同様に、（a）罰則を受けたメンバーが負うコストと（b）罰則を科すコストの比は３：１です。あなたの利得も同様に、他の４人のメンバーの罰則行動で低減します。他のメンバーの利得を減らしたくない場合は該当する欄に０を入力してください。

あなたに向けられた削減ポイントによる損失により、当該ラウンドの利得がゼロより小さくなることはありません。しかしながら、既に利得がゼロになっていても、あなた自身が他のメンバーの利得を減らすために負ったコストは常に発生します（当該ラウンドの利得が負になる場合は他のラウンドの利得から支払うことになります）。

注：コンピュータ画面の数値は例示です。

当該フェーズにおける各ラウンドの利得は以下の式によって計算されます。

式：Part A − Part B

Part A：配分ステージの利得からあなたが受けた削減ポイントによる損失を差し引いた総ポイント数（もし値が負になる場合は０）

Part B：他のメンバーの利得を減らすために使用したあなたの削減ポイントの使用費用

削減ポイントの使用に関して２つの制約があります。まず、削減ポイントは整数でなければいけません。次に、どのメンバーにも１０削減ポイントを超えて割り振ることはできません。仮に他のメンバーの利得を減らしたくない場合は該当する欄に０を入力してください。

パート２の配分問題ラウンドにおける追加タスク

毎ラウンド、追加で１ポイントを獲得する機会があります。つまり、各ラウンドで財産の配分の意思決定をするスクリーンで別のタスクがあります。以下の画面はパート２の各ラウンドで実際に見るコンピュータ画面の例になります。配分問題の下部に字が青色、赤色、紫色、または黒色で表示されます。これに対し、字が何色で映っているかを聞かれます。例えば下の画面では「赤」の字が赤色で表示しています。この場合は正解は赤になります。字の意味（下の例では「赤」）は常にその色で画面上に表示されます。

色を答える問題に正解するごとに追加で１ポイントを獲得することが出来ます。 パート２には２４ラウンドあることから、合計２４ポイントまでこのタスクから獲得することが出来ます。

注：コンピュータ画面の数値は例示です。

パート２（フェーズ２から７）の要約

パート２は８分間の「e」を消すタスクから始まります。その後、６フェーズからなる配分問題での交流に移ります。

各フェーズの開始とともに、「グループ罰則ルール」か「個人罰則ルール」を多数決で選択します。

(i) グループ罰則ルールが選ばれた場合

毎ラウンド、罰則率を投票します。５人により投票された率の中央値があなたのグループに適用されます。選ばれた罰則率のもとで、あなたと他４人のメンバーは同時に、２０ポイントの財産を個人会計とグループ会計の間でどのように配分するか意思決定をします。当該フェーズには４ラウンドあるため、罰則率の選択機会は合計４回あります。

(ii) 個人罰則ルールが選ばれた場合

毎ラウンド、あなたはまず、財産のうち何ポイントをグループ会計に配分するか決定します。その後で他のメンバーの配分額が知らされ、あなたは４人それぞれの利得を何ポイント減らすか意思決定します。

パート２には６フェーズ（フェーズ２から７）あるため、スキーム選択の機会は合計６回あります。

確認問題:

次の問題に答えてください。質問等があれば個別に答えますので手をあげてください。

1. ２種類のスキームの投票について

a) パート２には合計何ラウンドありますか？ _____

b) ２種類のスキーム選定のために投票する機会は合計何回ありますか？_____

c) フェーズ３（ラウンド９から１２）であなたのグループがグループ罰則ルールを選択したと想定してください。フェーズ４（ラウンド１３から１６）で個人罰則ルールを選択することは可能ですか？ _____

2. グループ罰則ルールがフェーズ３で選択されたと想定してください。

a) 罰則スキームを運営するための固定費用は各ラウンドで何ポイントかかりますか？

_____

b) 罰則率に対するグループ５人の投票が 0.4、0.8、0、0.8、1.2 であったと想定してください。グループで遂行される率はいくつですか？ _____

c) グループで遂行された罰則率が 0.4 と想定してください。あなたがグループ会計に１５ポイントを配分した場合に課される罰則は何ポイントになりますか？* _____
* 注: 罰則を科すための変動型運営費は含みません。その質問は以下になります。
その罰則を科すための費用として、あなたはいくら払わないといけませんか？（同じ費用を他の４人のメンバーも支払います）_____

3. 個人罰則ルールがフェーズ３で選択されたと想定してください。

第１０ラウンドにあるメンバーの利得を６ポイント減らすためにはいくら支出する必要がありますか？ _____

A.3. Six paragraphs used for the crossing-out task

Question 1 (“Pride and Prejudice” by Jane Austen (1813)):

> It is a truth universally acknowledged, that a single man in possession of a good fortune, must be in want of a wife. However little known the feelings or views of such a man may be on his first entering a neighbourhood, this truth is so well fixed in the minds of the surrounding families, that he is considered the rightful property of some one or other of their daughters. "My dear Mr. Bennet,” said his lady to him one day, “have you heard that Netherfield Park is let at last?” Mr. Bennet replied that he had not. “But it is,” returned she; “for Mrs. Long has just been here, and she told me all about it.”

Question 2 (“Nineteen Eighty-Four” by George Orwell (1949)):

> It was a bright cold day in April, and the clocks were striking. Winston Smith, his chin nuzzled into his breast in an effort to escape the vile wind, slipped quickly through the glass doors of Victory Mansions, though not quickly enough to prevent a swirl of gritty dust from entering along with him. The hallway smelt of boiled cabbage and old rag mats. At one end of it a coloured poster, too large for indoor display, had been tacked to the wall.

Question 3 (“Harry Potter and the Philosopher's Stone” by J.K. Rowling (1997)):

Mr and Mrs Dursley, of number four, Privet Drive, were proud to say that they were perfectly normal, thank you very much. They were the last people you'd expect to be involved in anything strange or mysterious, because they just didn't hold with such nonsense. Mr Dursley was the director of a firm called Grunnings, which made drills. He was a big, beefy man with hardly any neck, although he did have a very large moustache.

Question 4 (“The Old Man and the Sea” by Ernest Hemingway (1952)):

He was an old man who fished alone in a skiff in the Gulf Stream and he had gone eighty-four days now without taking a fish. In the first forty days a boy had been with him. But after forty days without a fish the boy's parents had told him that the old man was now definitely and finally salao, which is the worst form of unlucky, and the boy had gone at their orders in another boat which caught three good fish the first week. It made the boy sad to see the old man come in each day with his skiff empty and he always went down to help him carry either the coiled lines or the gaff and harpoon and the sail that was furled around the mast. The sail was patched with flour sacks and, furled, it looked like the flag of permanent defeat.

Question 5 (“Don Quixote” by Miguel de Cervantes, 1605 (translated in 1885)):

In a village of La Mancha, the name of which I have no desire to call to mind, there lived not long since one of those gentlemen that keep a lance in the lance-rack, an old buckler, a lean hack, and a greyhound for coursing. An olla of rather more beef than mutton, a salad on most nights, scraps on Saturdays, lentils on Fridays, and a pigeon or so extra on Sundays, made away with three-quarters of his income. The rest of it went in a doublet of fine cloth and velvet breeches and shoes to match for holidays, while on week-days he made a brave figure in his best homespun. He had in his house a housekeeper past forty, a niece under twenty, and a lad for the field and market-place, who used to saddle the hack as well as handle the bill-hook. The age of this gentleman of ours was bordering on fifty; he was of a hardy habit, spare, gaunt-featured, a very early riser and a great sportsman.

Question 6 (“A Tale of Two Cities” by Charles Dickens (1859)):

It was the best of times, it was the worst of times, it was the age of wisdom, it was the age of foolishness, it was the epoch of belief, it was the epoch of incredulity, it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair, we had everything before us, we had nothing before us, we were all going direct to Heaven, we were all going direct the other way - in short, the period was so far like the present period, that some of its noisiest authorities insisted on its being received, for good or for evil, in the superlative degree of comparison only.

Appendix B: Additional Figures and Tables

Table B.1: *Performance in the Depletion/Non-depletion Task*

The average performances in the crossing-out task and the average accuracy rates in the Stroop task across all periods are significantly better in the non-depletion treatment than in the depletion treatment. However, the performances and accuracy rates are economically very similar for the four treatments, as expected (see the tables below). For example, although additional effort is required, answering the color questions correctly is not difficult even in the depletion condition. This means that there are almost no differences in the wealth level of subjects between the depletion and non-depletion conditions due to the inclusion of the depletion or non-depletion tasks. This helps remove confounding factors, such as wealth effects, when identifying the effect of self-regulatory resources on subjects' institutional choices.

[I. Avg. numbers of questions correctly answered in the crossing-out task:]

Treatment	Avg # of questions correctly answered
No-D	0.067
No-N	0.378
Voting-D	0.133
Voting-N	0.400

	Two-sided p (Mann-Whitney tests)		
Treatment	No-N	Voting-D	Voting-N
No-D	0.003	0.2663	0.0055
No-N	---	0.0614	1.0000
Voting-D	---	---	0.0727
Voting-N	---	---	---

[II. Accuracy rates in the Stroop task (the color questions):]

Treatment	Accuracy rate
No-D	98.1%
No-N	99.8%
Voting-D	99.0%
Voting-N	100.0%

	Two-sided p (Mann-Whitney tests)		
Treatment	No-N	Voting-D	Voting-N
No-D	0.0061	0.522	0.0010
No-N	---	0.035	0.5546
Voting-D	---	---	0.0043
Voting-N	---	---	---

The following table shows the average accuracy rates for the color questions, period by period, by treatment. It suggests that almost every subject answered the Stroop task correctly.

	Phase 2				Phase 3				Phase 4			
Treatment	Ph. 5	Ph. 6	Ph. 7	Ph. 8	Ph. 9	Ph. 10	Ph. 11	Ph. 12	Ph. 13	Ph. 14	Ph. 15	Ph. 16
No-D	93.3%	97.8%	93.3%	100%	100%	100%	97.8%	100%	95.6%	95.6%	95.6%	97.8%
No-N	95.6%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Voting-D	91.1%	97.8%	97.8%	100%	93.3%	97.8%	100%	100%	100%	100%	100%	100%
Voting-N	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

	Phase 5				Phase 6				Phase 7			
Treatment	Ph. 17	Ph. 18	Ph. 19	Ph. 20	Ph. 21	Ph. 22	Ph. 23	Ph. 24	Ph. 25	Ph. 26	Ph. 27	Ph. 28
No-D	97.8%	100%	97.8%	97.8%	100%	100%	97.8%	97.8%	100%	100%	100%	100%
No-N	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Voting-D	100%	100%	100%	100%	100%	97.8%	100%	100%	100%	100%	100%	100%
Voting-N	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table B.2: *Treatment Effects of Self-regulatory Resources and Voting on Contributions* (supplementing Table 2 of the paper)

The following compares the treatment results from Mann-Whitney tests and regressions. It shows that (a) Part 1 contribution behavior did not vary by treatment condition, (b) voting on sanction schemes significantly improved cooperation in Part 2, and (c) the manipulation of self-regulatory resources did not affect the positive effects of punishment. Note that Result (a) is as expected since Part 1 is identical in every treatment. Result (c) suggests that prior research findings on the effects of punishment (whether formal or informal) are robust to the amounts of people's self-regulatory resources. As discussed in the main text (paper), Result (c) was also driven by the fact that members chose schemes in the experiment appropriately dependent according to their self-regulatory resources.

[I. Mann-Whitney and Fisher's Exact Tests:]

The following panels, (i) to (iii), supplement Figure 2 of the main text and include two-sided *p*-values to compare the treatment efficiencies based on group-level Mann-Whitney tests.

(i) Average contribution in Part 1 (Periods 1 to 4)

	No Voting	No-D	No-N	Voting-D
Voting	0.9159	---	---	---
No-D	---	---	---	---
No-N	---	0.4894	---	---
Voting-D	---	0.3865	0.9497	---
Voting-N	---	0.9626	0.5414	0.4234

(ii) Average contribution in Part 2 (Periods 5 to 28)

	No Voting	No-D	No-N	Voting-D
Voting	0.0001***	---	---	---
No-D	---	---	---	---
No-N	---	0.2475	---	---
Voting-D	---	0.0060***	0.0030***	---
Voting-N	---	0.0224**	0.0109**	0.3573

(iii) Average payoff in Part 2 (Periods 5 to 28)

	No Voting	No-D	No-N	Voting-D
Voting	0.0349**	---	---	---
No-D	---	---	---	---
No-N	---	0.2581	---	---
Voting-D	---	0.0770*	0.1135	---
Voting-N	---	0.3213	0.1996	0.6730

Notes: *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. The "Voting" in the panel includes the observations for both the Voting-D and Voting-N treatments. The "No Voting" includes the observations for both the No-D and No-N treatments.

The following panels, (iv) to (vi), include *p*-values for group-level Fisher's exact tests.

(iv) % of groups whose Part 1 average contributions were ≥ 10 (half of the endowment)

	%			Two-sided *p* from Fisher's exact tests:			
				No Voting	No-D	No-N	Voting-D
No Voting	33.33%		No Voting	---	---	---	---
Voting	41.67%		Voting	1.000	---	---	---
No-D	33.33%		No-D	---	---	---	---
No-N	33.33%		No-N	---	1.000	---	---
Voting-D	22.22%		Voting-D	---	1.000	1.000	---
Voting-N	37.50%		Voting-N	---	1.000	1.000	0.6199

(v) % of groups whose Part 2 average contributions were ≥ 10 (half of the endowment)

	%			Two-sided *p* from Fisher's exact tests:			
				No Voting	No-D	No-N	Voting-D
No Voting	11.11%		No Voting	---	---	---	---
Voting	70.59%		Voting	0.0005***	---	---	---
No-D	11.11%		No-D	---	---	---	---
No-N	11.11%		No-N	---	1.000	---	---
Voting-D	77.78%		Voting-D	---	0.0152**	0.0152**	---
Voting-N	62.50%		Voting-N	---	0.0498**	0.0498**	0.6199

(vi) % of groups whose Part 2 average payoffs were ≥ 30

	%			Two-sided *p* from Fisher's exact tests:			
				No Voting	No-D	No-N	Voting-D
No Voting	11.11%		No Voting	---	---	---	---
Voting	64.71%		Voting	0.0016***	---	---	---
No-D	11.11%		No-D	---	---	---	---
No-N	11.11%		No-N	---	1.000	---	---
Voting-D	77.78%		Voting-D	---	0.0152**	0.0152**	---
Voting-N	50.00%		Voting-N	---	0.1312	0.1312	0.3348

Notes: *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. The "Voting" in the panel includes the observations for both the Voting-D and Voting-N treatments. The "No Voting" includes the observations for both the No-D and No-N treatments.

[II. Regression Analysis:]

The analysis below finds that voting on sanction schemes significantly improves contributions regardless of the treatment considered (II.i). In addition, voting improves payoffs—see Models 1 and 2 in II.ii, where pooled data are used (this is consistent with the non-parametric analysis in Part I above).

II.i. Dependent variable: Contribution amount of Subject *i* in Period *t*, where $t > 4$

As the number of censored observations is large, not only a linear but also a tobit regression model is estimated below.

Estimation method: / Independent variables:	Subject random effects linear regression with standard errors clustered at the group level				Subject random effects tobit regression with standard errors bootstrapped at the group level (200 replications)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) Voting dummy {=1 for the Voting-N and Voting-D treatments }	8.973***	9.071***	7.173***	7.057***	20.764***	20.768***	14.523***	14.302***
	(1.826)	(1.804)	(2.531)	(2.529)	(3.800)	(4.771)	(5.446)	(5.349)
(b) Depletion dummy {= 1 for the No-D and Voting-D treatments}	---	---	1.222	1.736	---	---	3.698	4.397
			(1.907)	(1.987)			(3.189)	(3.399)
(c) Interaction: (a) × (b)	---	---	3.468	4.027	---	---	12.142	12.916
			(3.609)	(3.686)			(7.504)	(8.393)
(d) Constant	5.836***	5.608***	5.225***	4.619*	2.584	0.417	0.727	-2.365
	(0.965)	(2.402)	(1.540)	(2.621)	(1.602)	(4.192)	(2.559)	(4.973)
# of observations	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200
R-squared	0.2732	0.2820	0.2841	0.2950	---	---	---	---
Wald χ^2	24.15	137.13	25.69	198.50	29.85	89.29	29.29	108.42
Prob > Wald χ^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
# of left-censored obs.	---	---	---	---	1,135	1,135	1,135	1,135
# of right-censored obs.	---	---	---	---	1,454	1,454	1,454	1,454
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes

Notes: The numbers in parentheses are robust standard errors. Observations from all treatments were used. [#1] The control variables include gender dummies, an economics major dummy, university year dummies, and political preferences. The coefficient estimates for these controls are omitted to conserve space. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

II.ii. Dependent variable: Payoff (excl. earnings from the Stroop task) of Subject *i* in Period *t*, where $t > 4$

Independent variables:	(1)	(2)	(3)	(4)
(a) Voting dummy {=1 for the Voting-N and Voting-D treatments; 0 otherwise}	4.423**	4.028**	3.280	3.200
	(1.941)	(1.934)	(2.462)	(2.433)
(b) Depletion dummy {= 1 for the No-D and Voting-D treatments; 0 otherwise}	---	---	1.222	0.472
			(1.907)	(2.002)
(c) Interaction: (a) × (b)	---	---	2.227	1.628
			(3.837)	(3.813)
(d) Constant	25.836***	24.615***	25.225***	24.279***
	(.965)	(2.354)	(1.540)	(2.601)
# of observations	4,200	4,200	4,200	4,200
R-squared	0.0662	0.0949	0.0705	0.0973
Wald χ^2	5.19	131.13	5.34	135.56
Prob > Wald χ^2	0.0227	0.0000	0.1488	0.0000
Control variable[#1]	No	Yes	No	Yes

Notes: Subject random effects linear regression with standard errors clustered at the group level. The numbers in parentheses are robust standard errors. Observations from all treatments were used. [#1] The control variables include gender dummies, an economics major dummy, university year dummies, and political preferences. The coefficient estimates for these controls are omitted to conserve space. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table B.3: *Contribution Dynamics by Treatment*

Dependent variable: Contribution amount of Subject *i* in Period *t*, where $t > 4$

Estimation method:	Subject random effects linear regression with standard errors clustered at the group level				Subject random effects tobit regression with standard errors bootstrapped at the group level (200 replications)			
Independent variables:	No-D (1)	No-N (2)	Voting-D (3)	Voting-N (4)	No-D (5)	No-N (6)	Voting-D (7)	Voting-N (8)
(a) Phase numbers in Part 2 {= 2, 3, 4, …, 8}	-0.203	-0.245	0.892**	-0.087	-0.371	-0.779	5.319[#1]	-0.090
	(0.515)	(0.247)	(0.373)	(0.341)	(0.891)	(0.542)	(7.769)	(0.636)
(b) Period number within Phase {= 1, 2, 3, 4}	-0.245	-0.174	0.280	0.015	-0.683*	-0.367	1.303	0.084
	(0.232)	(0.197)	(0.192)	(0.154)	(0.388)	(0.422)	(3.085)	(0.283)
(c) Constant	7.973***	6.765***	11.153***	13.976***	7.703*	5.482	13.419	17.074***
	(2.364)	(2.363)	(2.949)	(1.687)	(4.165)	(3.578)	(139.431)	(3.287)
# of observations	1,080	1,080	1,080	960	1,080	1,080	1,080	960
R-squared	0.0039	0.0040	0.0431	0.0004	---	---	---	---
Wald χ^2	1.11	1.31	5.79	1.35	3.12	2.15	0.88	2.35
Prob > Wald χ^2	0.5738	0.5204	0.0554	0.5092	0.2098	0.3419	0.6443	0.3088
# of left-censored obs.	---	---	---	---	371	518	152	94
# of right-censored obs.	---	---	---	---	152	142	777	383

Notes: The numbers in parentheses are robust standard errors.

*, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

Remark: Additional regressions were performed by including control variables (gender dummies, an economics major dummy, university year dummies, and political preferences). The coefficient estimates in (a) and (b) are qualitatively similar, except for #1. The coefficient estimate for #1 is significant at the 5% level when these control variables are added. The estimation results are omitted to conserve space.

Table B.4: *Effects of Self-regulatory Resources on Contributions by Sanction Scheme*
(supplementing Figure 4 of the paper)

[I. Treatment Differences:]

The table below shows that both the FS and IS schemes significantly improved contributions (see the variables in (a) and (b)). There are no statistical differences in the effect between the two schemes. The state of self-regulatory resources (depleted or not depleted) did not alter the strong effects (see the variables in (d) and (e)).

Dependent variable: Contribution amount of Subject *i* in Period *t*, where $t > 4$

Estimation method: / Independent variables:	Subject random effects linear regression with standard errors clustered at the group level				Subject random effects tobit regression with standard errors bootstrapped at the group level (200 replications)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) FS dummy {=1 when the FS scheme was in use; 0 otherwise}	8.044*** (3.125)	8.106*** (3.137)	8.925*** (2.629)	9.319*** (2.610)	19.886*** (7.577)	19.851*** (7.231)	20.669*** (7.018)	21.139*** (5.941)
(b) IS dummy {=1 when the IS scheme was in use; 0 otherwise}	9.678*** (2.025)	9.789*** (1.995)	8.289*** (2.745)	8.709*** (2.730)	21.388*** (4.754)	21.407*** (5.071)	17.720*** (6.168)	18.201*** (4.480)
(c) Depletion dummy {= 1 for the No-D and Voting-D treatments; 0 otherwise}	---	---	1.222 (1.908)	1.742 (1.990)	---	---	3.687 (2.847)	4.371 (3.062)
(d) Interaction: (a) × (c)	---	---	-0.573 (4.392)	-1.069 (4.334)	---	---	0.796 (11.049)	0.156 (10.018)
(e) Interaction: (b) × (c)	---	---	3.262 (4.244)	2.773 (4.252)	---	---	7.566 (10.413)	6.965 (9.601)
(f) Constant	5.836*** (0.965)	5.658** (2.398)	5.225*** (1.541)	4.528* (2.644)	2.582 (1.667)	0.432 (4.403)	0.746 (2.499)	-2.432 (5.007)
# of observations	4,200	4,200	4,200	4,200	4,200	4,200	4,200	4,200
# of left-censored obs.	---	---	---	---	1,135	1,135	1,135	1,135
# of right-censored obs.	---	---	---	---	1,454	1,454	1,454	1,454
R-squared	0.2559	0.2651	0.2839	0.2955	---	---	---	---
Wald χ^2	26.94	146.57	35.43	237.16	33.45	108.82	29.41	133.81
Prob > Wald χ^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes
Wald test for H_0: (a) = (b)								
Chi-squared	0.22	0.23	0.89	0.92	0.02	0.03	0.19	0.23
Two-sided *p*-value	0.6422	0.6343	0.3449	0.3379	0.8775	0.8558	0.6648	0.6352

Notes: The observations from all four treatments in Part 2 were used. The observations in the No-N treatment are the reference groups. The numbers in parentheses are robust standard errors. The control variables include gender dummies, an economics major dummy, university year dummies, and political preferences. [#1] The coefficient estimates for these controls are omitted to conserve space.

*, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

[II. Dynamics:]

The table below indicates that when members' self-regulatory resources were limited (the Voting-D treatment), the groups significantly improved cooperation from period to period under the IS scheme. See Models 3 and 7.

Dependent variable: Contribution amount of Subject *i* in Period *t*, where $t > 4$, in either Voting-D treatment or Voting-N treatment

Estimation method:	Subject random effects linear regression with standard errors clustered at the group level				Subject random effects tobit regression with standard errors bootstrapped at the group level (200 replications)			
	FS scheme		IS scheme		FS scheme		IS scheme	
Independent variables:	Voting-D (1)	Voting-N (2)	Voting-D (3)	Voting-N (4)	Voting-D (5)	Voting-N (6)	Voting-D (7)	Voting-N (8)
(a) Phase numbers in Part 2 {= 2, 3, 4, …, 8}	0.512 (0.437)	0.098* (0.052)	0.695*** (0.188)	-0.125 (0.417)	7.046 (30.843)	3.208 (10.039)	2.622[#1] (5.695)	-0.202 (0.703)
(b) Period number within Phase {= 1, 2, 3, 4}	0.330 (0.267)	0.190 (0.170)	0.179 (0.206)	-0.021 (0.173)	3.865 (14.899)	1.713*** (0.318)	0.487 (1.200)	-0.011 (0.298)
(d) Constant	10.914*** (3.859)	17.472*** (1.771)	9.947*** (3.025)	13.348*** (1.790)	34.570 (250.998)	11.149 (21.730)	5.963 (15.888)	15.868*** (3.611)
# of observations	720	160	360	800	720	160	360	800
R-squared	0.0381	0.0025	0.0594	0.0000	---	---	---	---
Wald χ^2	1.60	71.49	19.29	0.37	0.10	311.04	0.22	0.88
Prob > Wald χ^2	0.4502	0.0000	0.0001	0.8301	0.9510	0.0000	0.8950	0.6452
# of left-censored obs.	---	---	---	---	132	1	20	93
# of right-censored obs.	---	---	---	---	553	138	224	245

Notes: The numbers in parentheses are robust standard errors. [#1] This coefficient estimate (standard errors) is 2.661 (0.740) and is significant at the 1% level when the control variables (gender dummies, an economics major dummy, university year dummies, and political preferences) are added. The other coefficient estimates and significance levels are qualitatively similar even when the control variables are added—the results are omitted to conserve space.

*, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table B.5: *Amounts of Members' Self-regulatory Resources and Scheme Choices*

(supplementing Table 3 of the paper)

Table 3 of the paper examines how the amount of self-regulatory resources affects subjects' scheme choices using a non-linear regression model (i.e., a probit [ordered probit] regression model to explain individual voting [a given group's vote share]). However, a typical concern in using such a model is that it is a large sample estimator. A linear probability model was also performed to accommodate this concern. Table B.5 summarizes the estimation results. Qualitatively, the results are the same as those in Table 3.

Dependent variable:	A dummy that equals 1(0) if Subject *i* voted for the FS (IS) scheme				The vote share of the FS scheme in Group $j \in \{0.0, 0.2, 0.4, 0.6, 0.8, 1.0\}$			
Estimation Method:	Subject random effects linear regressions with robust standard errors clustered by group ID[#2]				Group random effects linear regressions			
Independent variables:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) Depleted dummy {= 1 for the Voting-D treatment; 0 otherwise}	0.274*** (0.098)	0.262** (0.111)	0.381*** (0.118)	0.369*** (0.123)	0.274*** (0.104)	0.275** (0.132)	0.381*** (0.119)	0.381*** (0.144)
(b) Vote number variable {=1, 2, …, 6}	---	---	0.018 (0.013)	0.018 (0.013)	---	---	0.018 (0.012)	0.018 (0.012)
(c) Interaction (a) × (b)	---	---	-0.031 (0.024)	-0.031 (0.024)	---	---	-0.031* (0.017)	-0.031* (0.017)
(d) Constant	0.304*** (0.055)	0.270 (0.169)	0.242 (0.085)	0.208 (0.189)	0.304*** (0.076)	0.247 (0.495)	0.242*** (0.087)	0.185 (0.497)
# of observations	510	510	510	510	102	102	102	102
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes
Wald χ^2	7.76	198.15	11.10	224.34	6.94	8.32	10.34	11.72
Prob > Wald χ^2	0.0053	0.0000	0.0112	0.0000	0.0084	0.1396	0.0159	0.1103

Notes: The numbers in parentheses are robust standard errors. The units of observations are individuals in Models 1 to 4, and groups in Models 5 to 8. [#1] The control variables include gender dummies, an economics major dummy, university year dummies, and political preferences in Models 2 and 4 [the percentages of female subjects, economics majors, and 1st-year undergraduate students and the average political preference in a given group in Models 6 and 8].

[#2] Group-level clustering is included as each individual's voting may be correlated within their group.

*, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table B.6: *Effects of Enacted Sanction Rates on Contributions in the FS Scheme*
(supplementing Panel A of Figure 4 of the paper)

Dependent variable: Contribution amount of Subject *i* in Period *t*, where $t > 4$, under the FS scheme

[Voting-D treatment:]

Estimation Method: / Independent variables:	Subject random effects linear regressions with robust S.E. clustered by group ID				Subject random effects tobit regressions with bootstrapped S.E. clustered by group ID[#2]			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) Sanction rates enacted in a group {= 0.0, 0.4, 0.8 or 1.2}	16.021*** (0.191)	16.126*** (0.109)	---	---	49.132** (22.050)	46.764*** (14.463)	---	---
(b) Deterrent dummy {= 1 if the group sanction rate is 0.8 or 1.2}	---	---	19.125*** (0.158)	19.154*** (0.118)	---	---	61.635** (25.997)	58.122*** (12.097)
(c) Constant	0.640*** (0.245)	0.028 (0.217)	0.718*** (0.154)	0.324* (0.173)	-12.014 (13.444)	-25.263*** (7.404)	-12.660 (12.088)	-24.190*** (6.969)
# of observations	720	720	720	720	720	720	720	720
# of left-censored obs.	---	---	---	---	132	132	132	132
# of right-censored obs.	---	---	---	---	553	553	553	553
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.9604	0.9618	0.9579	0.9591	---	---	---	---
Wald χ^2	7055.89	..	14639.28	..	4.97	80.86	5.62	106.79
Prob > Wald χ^2	0.0000	..	0.0000	..	0.0259	0.0000	0.0177	0.0000

[Voting-N treatment:]

Estimation Method: / Independent variables:	Subject random effects linear regressions with robust S.E. clustered by group ID				Subject random effects tobit regressions with bootstrapped S.E. clustered by group ID[#2]			
	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(a) Sanction rates enacted in a group {= 0.0, 0.4, 0.8 or 1.2}	3.524* (1.991)	3.459* (1.947)	---	---	17.210*** (2.864)	16.745*** (1.664)	---	---
(b) Deterrent dummy {= 1 if the group sanction rate is 0.8 or 1.2}	---	---	2.497** (1.131)	2.463** (1.076)	---	---	11.007*** (2.787)	10.167*** (0.934)
(c) Constant	15.800*** (2.455)	13.468*** (1.629)	17.078*** (1.814)	13.408*** (1.689)	13.223*** (1.991)	13.889 (157.336)	20.409*** (2.520)	14.364 (53.377)
# of observations	160	160	160	160	160	160	160	160
# of left-censored obs.	---	---	---	---	1	1	1	1
# of right-censored obs.	---	---	---	---	138	138	138	138
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.3085	0.3589	0.2242	0.3150	---	---	---	---
Wald χ^2	3.13	..	4.87	..	36.12	..	15.59	..
Prob > Wald χ^2	0.0768	..	0.0273	..	0.0000	..	0.0001	..

Notes: The numbers in parentheses are robust standard errors. [#1] The control variables include gender dummies, an economics major dummy, university year dummies, and political preferences. [#2] The number of bootstrap replications is 200. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table B.7: *Effects of Self-regulatory Resources on Voting on the Sanction Rate in the FS Scheme* (supplementing Figure 4 of the paper)

The regression results below show that subjects' voting on the sanction rate in the FS scheme was unaffected by the amount of their self-regulatory resources (depleted or not depleted). This suggests a high robustness of prior research on people's effective voting under the FS (Putterman et al., 2010).

Dependent Variable:	A. Sanction rate voted by Subject *i* in Period *t* in the FS scheme {= 0.0, 0.4, 0.8 or 1.2}							
Estimation Method:	Subject random effects linear regressions with robust S.E. clustered by group ID				Subject random effects tobit regressions with bootstrapped S.E. clustered by group ID[#2]			
Independent variables:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) Depleted dummy {=1 for the Voting-D treatment}	0.166	0.040	0.120	0.006	2.091	0.665	1.633	0.391
	(0.154)	(0.107)	(0.157)	(0.106)	(1.589)	(1.777)	(1.681)	(2.359)
(b) Vote number variable {=1, 2, …, 6}	---	---	0.036***	0.036***	---	---	0.627*	0.616
			(0.002)	(0.001)			(0.354)	(0.499)
(c) Interaction (a) × (b)	---	---	0.009	0.007	---	---	0.026	0.037
			(0.022)	(0.022)			(0.555)	(0.548)
(d) Constant	0.658***	0.272	0.556***	0.147	1.128*	-3.628	-0.610	-5.775*
	(0.092)	(0.273)	(0.085)	(0.288)	(0.684)	(3.496)	(0.639)	(3.136)
# of observations	880	880	880	880	880	880	880	880
# of left-censored obs.	---	---	---	---	218	218	218	218
# of right-censored obs.	---	---	---	---	603	603	603	603
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.0057	0.1159	0.0337	0.1439	---	---	---	---
Wald χ^2	1.17	1452.26	828.57	..	1.73	24.75	6.75	38.15
Prob > Wald χ^2	0.2801	0.0000	0.0000	..	0.1882	0.0017	0.0805	0.0000

Dependent Variable:	B. A dummy that equals 1 if Subject *i* voted for a deterrent sanction rate {0.8 or 1.2} in Period *t* in the FS scheme							
Estimation Method:	Subject random effects linear regressions with robust S.E. clustered by group ID				Subject random effects probit regressions with bootstrapped S.E. clustered by group ID[#2]			
Independent variables:	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
(a) Depleted dummy {=1 for the Voting-D}	0.139	0.035	0.083	-0.013	0.904	0.319	0.543	-0.046
	(0.132)	(0.094)	(0.133)	(0.089)	(0.866)	(0.803)	(0.863)	(0.945)
(b) Vote number variable {=1, 2, …, 6}	---	---	0.025***	0.025***	---	---	0.213**	0.207
			(0.001)	(0.001)			(0.090)	(0.219)
(c) Interaction between (a) × (b)	---	---	0.013	0.013	---	---	0.100	0.107
			(0.018)	(0.018)			(0.233)	(0.251)
(d) Constant	0.547***	0.249	0.477***	0.165	0.281	-2.034	-0.308	-2.884
	(0.081)	(0.225)	(0.074)	(0.235)	(0.691)	(1.459)	(0.631)	(1.852)
# of observations	880	880	880	880	880	880	880	880
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.0045	0.1130	0.0308	0.1411	---	---	---	---
Wald χ^2	1.11	..	559.32	..	1.09	53.88	11.36	129.30
Prob > Wald χ^2	0.2913	..	0.0000	..	0.2968	0.0000	0.0100	0.0000

Notes: The numbers in parentheses are robust standard errors. [#1] The control variables include gender dummies, an economics major dummy, university year dummies, and political preferences. [#2] The number of bootstrap replications is 200.

*, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table B.8: *Average Informal Punishment Received*

(supplementing Panel D of Figure 4 of the paper)

The table below shows that pro-social punishment (see Row A) is significantly stronger in the Voting-D treatment than in the Voting- N treatment. It also suggests that pro-social punishment is much stronger than anti-social punishment, an implication that was confirmed by a rigorous regression analysis (Table B.9) that explicitly incorporated the difference between $c_{i,t}$ and $\overline{c_t}$ in the model.

Situation	Average reduction loss incurred by Subject *i* due to punishment received from the other four members[#1]		Two-sided *p*-value for z test[#2] of H_0: i = ii
	i. Voting-D treatment	ii. Voting-N treatment	
A. When *i*'s contribution amount $c_{i,t}$ is *less than* their group's average contribution amount $\overline{c_t}$ in Period *t* (pro-social punishment)	15.865*** (S.E. = 3.162, $N = 69$)	6.341* (S.E. = 3.406, $N = 291$)	$p = 0.031$** ($z = 2.16$, $N = 360$)
B. When *i*'s contribution amount $c_{i,t}$ is *not less than* their group's average contribution amount $\overline{c_t}$ in Period *t* (anti-social punishment)	4.205* (S.E. = 2.334, $N = 291$)	1.169 (S.E. = 0.517, $N = 509$)	$p = 0.185$ ($z = 1.32$, $N = 800$)
Two-sided *p*-value for z test to H_0: A = B	$p = 0.006$*** ($z = 2.72$, $N = 360$)	$p = 0.062$* ($z = 1.87$, $N = 800$)	---

Notes: The standard errors in the table were clustered at the group level.

[#1] In calculating the average reduction amounts, subject random effects were controlled for to accommodate the panel data structure. Thus, the values in this table are slightly different from those in Panel D of Figure 4.

[#2] For the same reason, subject random effects were controlled for to perform two-sided z tests.

*, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively. S.E. denotes standard errors.

Table B.9: *Contribution Decisions and Informal Punishment Received*

The results of the regression analysis below show that subjects who contributed less than the average contribution in their group received significantly positive punishment. It also indicates that while high contributors also received punishment, as has been observed in prior research (e.g., Ostrom, 1992), pro-social punishment is significantly stronger than such anti-social punishment. These patterns were detected for both the Voting-D and Voting-N treatments.

Dependent variable: Total reduction amounts incurred by Subject *i* through punishment received from the four other group members (= 3 times total punishment points received by *i*) in Period *t* in the IS scheme.

Estimation Method:	Subject random effects linear regressions with robust S.E. clustered by group ID				Subject random effects tobit regressions with bootstrapped S.E. clustered by group ID[#2]			
	I. Voting-D		II. Voting-N		III. Voting-D		IV. Voting-N	
Independent variables:	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
(a) Positive deviation (= max{*i*'s contribution amount $c_{i,t}$ minus their group's average contribution amount $\bar{c}_t$,0})	0.613**	0.604**	0.414**	0.411**	1.250**	1.280***	0.574	0.575
	(0.302)	(0.304)	(0.178)	(0.177)	(0.622)	(0.386)	(0.900)	(0.787)
(b) Absolute negative deviation (= max{their group's average contribution amount $\bar{c}_t$ minus *i*'s contribution amount $c_{i,t}$, 0})	2.057***	2.029**	2.141***	2.153***	2.930***	2.912***	3.174***	3.190***
	(0.769)	(0.803)	(0.604)	(0.601)	(0.632)	(0.659)	(0.775)	(0.674)
(c) Vote number variable {=1, 2, …, 6}[#3]	-0.388***	-0.344***	-0.389	-0.387	-3.240**	-3.269***	-1.889**	-1.871**
	(0.131)	(0.121)	(0.291)	(0.289)	(1.290)	(0.417)	(0.766)	(0.795)
(d) Periods within phases {=1, 2, 3, 4}	-0.211	-0.214	-0.079	-0.078	-0.620	-0.635	-0.453***	-0.441***
	(0.608)	(0.614)	(0.158)	(0.159)	(1.484)	(1.277)	(0.151)	(0.141)
(e) Constant	4.564**	1.899	2.008	2.334	3.755	6.298	-2.036	1.374
	(2.140)	(5.585)	(1.582)	(1.858)	(5.848)	(9.382)	(2.152)	(5.370)
# of observations	360	360	800	800	360	360	800	800
# of left-censored obs.	---	---	---	---	242	242	551	551
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.4884	0.5021	0.3809	0.4308	---	---	---	---
Wald χ^2	18.11	..	26.58	..	81.98	533.99	43.48	124.19
Prob > Wald χ^2	0.0012	..	0.0000	..	0.0000	0.0000	0.0000	0.0000
Wald test for H_0: (a) = (b)								
Chi-squared	4.12	4.13	12.50	13.22	7.38	13.76	5.51	7.15
Two-sided *p*-value	0.0424**	0.0421**	0.0004***	0.0003***	0.0066***	0.0002***	0.0189**	0.0075***

Notes: The numbers in parentheses are robust standard errors (S.E.s). [#1] The control variables include gender dummies, an economics major dummy, university year dummies, and political preferences. [#2] The number of bootstrap replications is 200. [#3] The vote number variable is equal to the phase number minus one.

*, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

Table B.10: *Effects of Informal Punishment Received in Period t – 1 on Contribution Decisions in Period t*

The results of the regression analysis below show that subjects who were pro-socially punished in Period t increased contributions in Period $t + 1$, *ceteris paribus*. Observations in the fourth periods of phases were not used in the regression analyses below due to potential end-game effects.

Dependent variable: Contribution amount of Subject i in the t-th period of Phase k in which the IS scheme is in effect.

Estimation Method:	Subject random effects linear regressions with robust S.E. clustered by group ID				Subject random effects tobit regressions with bootstrapped S.E. clustered by group ID[#2]			
Independent variables:	I. Voting-D		II. Voting-N		III. Voting-D		IV. Voting-N	
	(1)	(2)	(1)	(2)	(1)[#3]	(2)	(1)	(2)
(a) Total reduction amount received from group members due to *pro-social* punishment in the t–1th period	0.126** (0.064)	0.125** (0.054)	0.194*** (0.046)	0.193*** (0.048)	0.167 (0.219)	0.243** (0.103)	0.207** (0.086)	0.206** (0.082)
(b) Total reduction amount received from other group members due to *anti-social* punishment in the t–1th period	-0.179*** (0.024)	-0.168*** (0.041)	-0.104 (0.093)	-0.102 (0.094)	-0.323 (0.730)	-0.307 (0.131)	-0.258 (0.254)	-0.260 (0.260)
(c) Avg contribution of i's group in the t–1th period	0.804*** (0.115)	0.728*** (0.171)	0.964*** (0.019)	0.962*** (0.020)	1.242 (1.073)	1.354 (0.366)	1.022*** (0.128)	1.034*** (0.121)
(d) Constant	3.319 (2.229)	3.019 (3.149)	0.159 (0.307)	-0.172 (0.665)	1.507 (11.217)	-5.281 (7.340)	0.674 (2.353)	-1.337 (1.911)
# of observations	180	180	400	400	180	180	45	45
# of left-censored obs.	---	---	---	---	9	9	120	120
# of right-censored obs.	---	---	---	---	114	114	400	400
Control variable[#1]	No	Yes	No	Yes	No	Yes	No	Yes
R-squared	0.6157	0.6422	0.8516	0.8520	---	---	---	---
Wald χ^2	489.43	..	3238.32	..	2.08	53.34	66.17	214.94
Prob > Wald χ^2	0.0000	..	0.0000	..	0.5557	0.0000	0.0000	0.0000

Notes: The numbers in parentheses are robust standard errors (S.E.s). Punishment received by Subject i in a given period is called pro-(anti-)social if i's contribution amount $c_{i,t}$ in that period was less than (was not less than) their group's average contribution amount $\overline{c_t}$. Reduction amounts in Rows (a) and (b) are three times the punishment received. Observations in the first rounds of phases were not used in the regression, as the attempt here was to examine the relationship between the t–1-th period punishment received and t-th period contribution.

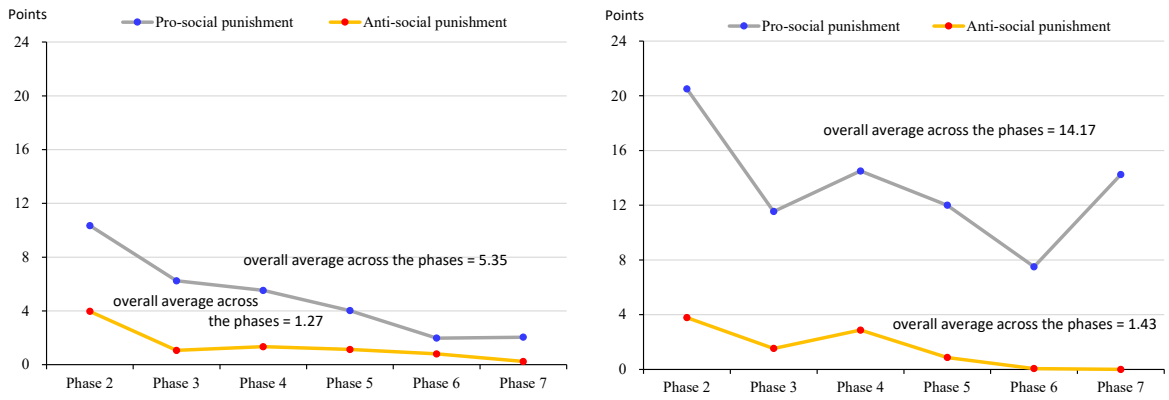
[#1] The control variables include gender dummies, an economics major dummy, university year dummies, and political preferences.

[#2] The number of bootstrap replications is 200.

[#3] All the coefficients do not have significant estimates and the goodness of the fit was poor for this model. This is presumably due to the small number of eligible observations. Recall that most groups decided to enact the FS scheme in the Voting-D treatment. A tobit regression model is a large-sample estimator.

*, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

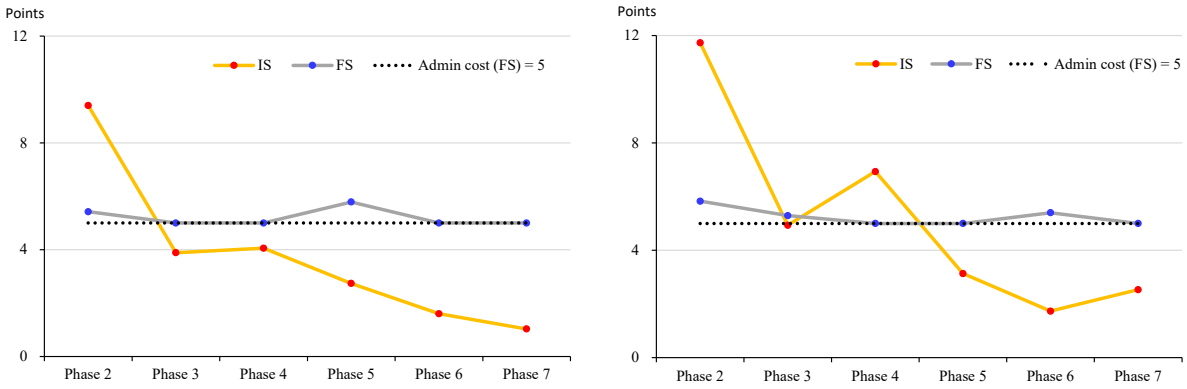
Figure B.1: *Average Per Period Loss due to Punishment Received in the IS Scheme by Treatment, Phase to Phase* (supplementing Panel D of Figure 4 of the paper)



i. Voting-N treatment ii. Voting-D treatment

Notes: The subjects' average per period loss due to (pro-social or anti-social) punishment received. Each number equals three times the average punishment points received from four members among the opportunities in the IS scheme (i.e., total loss due to punishment received divided by the total number of opportunities to be punished).

Figure B.2: *Average Per Period Loss from Having the Sanction Scheme* (supplementing Panel D of Figure 4 of the paper)



i. Voting-N treatment ii. Voting-D treatment

Notes: The average per period loss from punishment activities in the FS scheme is 5 + average fines received by subjects + average per capita share of imposing fines. The figures above show that members do not receive the variable costs in almost all the cases under the FS scheme. The average per period loss in the IS scheme is four times the average punishment points given (i.e., it is the sum of the average cost on the punished and that on the punishers).

Appendix C: Results from the Supplementary Survey

C.1. Questions included in the survey

The following questions were included in the opinion survey on the Covid-19 pandemic that was conducted in July 2022. All third- and fourth-year students in the subject database (ORSEE) of the Experimental Economics Laboratory, Research Institute of Socionetwork Strategies at Kansai University were sent invitation messages for this survey. They registered for and participated in the survey only if they were interested in doing so. The survey was conducted in Japanese. The participants received a payment of 1,000 Japanese yen in the form of an Amazon e-gift card for completing this survey.

C.1.1. Eliciting self-control behaviors

The following question about their own self-control behaviors under the state of emergency was posed to the respondents:

***

The state of emergency was declared four times at the Osaka Prefecture, and strong restriction measures were then introduced (the first state of emergency was from April 7 to May 21, 2020; the second one was from January 13 to March 1, 2021; the third was from April 25 to June 20, 2021; and the fourth was from August 2 to September 30, 2021).

Question: How many examples among the following ten are applicable to your typical way of spending time under the state of emergency? Answer by submitting an integer between 0 and 10.

[Seven examples that explain their weak self-control behaviors:]

- I went out to a grocery store for shopping, as usual.
- I usually ate out for lunch.
- I sometimes ate out with friends for dinner.
- I sometimes went out because I felt bored staying long at home.
- I went out for a part-time job (that was not online based) unless my employers cancelled the job.
- I went to the university to engage in students' activities or club activities even when there were no classes to attend.
- I saw my relatives (and/or your parents if you lived all by yourself), as normal. The frequency of seeing them was not much affected by the declaration of the state of emergency.

[The original Japanese version of the seven examples can be found below (the survey was conducted in Japanese):]

- 買い物はスーパーマーケット等に行って済ませた。
- 昼食は外食で済ますことが多かった。
- 時々、友達などと夜、外食をした。
- 家にずっといると退屈なので時々外出した。
- オンラインベースでないアルバイトは、アルバイト先がキャンセルしない限り、普段通り行った。
- サークルやクラブ活動のため大学には授業がなくても行くことがあった。
- 親戚（や［下宿している場合］実家の両親）に会う頻度は非常事態宣言によって影響をあまり受けなかった。

[In addition to the above seven examples, the following three examples that describe desirable self-restraint behaviors are included:]

- I often brought antibacterial wipe(s) or spray with me when leaving home.
- I tried avoiding using public transportation (such as trains and buses) as much as possible.
- I tried maintaining a social distance larger than usual in public spaces.

[The original Japanese version of the three examples distributed can be found below:]
- 外出時はしばしば除菌ワイプ／スプレーを持参して感染対策に気を付けて行動した。
- 電車・バスなどの公共交通機関に乗るのをできるだけ避けた。
- 外出時のソーシャル・ディスタンス（人との距離）は平常時よりも出来るだけ確保するように心がけた。

C.1.2. Perception of others' self-control behavior

The following question was asked regarding their perception of others' self-control behavior under the state of emergency:

Question: We are interested in knowing your opinions and observations concerning how **others (people except you)** reacted to the government's restriction measures.

Select the option that fits your observations the most among the followings, regarding how other people and students (except you) reacted to the declaration of the state of emergency.

A. In general, they complied with almost all the restriction measures imposed in the region (e.g., stay home if allowed).

B. Although almost all of them could not comply with every restriction measure, they still exercised self-control more than usual, for example, by reducing the number of times they went out to cities, public spaces, restaurants, pubs, bars, etc.

C. Many people did not comply with the government's requests and had a normal life without caring about the state of emergency.

D. Many people behaved rather socially and exercised less self-control than usual while the state of emergency was in effect.

[Original Japanese version of the question:]

政府の自粛要請期間中の、**あなたを除く他の人々**の行動について以下の質問に答えてください。

非常事態宣言中の人々（あなたを除く学生や一般の人々）の行動について、あなたのお考えに最も近い選択肢を一つ選んでください。

A 概ね多くの人はステイホームなど政府の自粛要請を守った行動していた。

B 政府の自粛要請通りの自制をしている人は少なかったが、それでも町など外に出る頻度を減らすなど概ね多くの人は普段よりも自制をした行動をとっていた。

C 多くの人は政府の自粛要請に従わず、自粛要請期間中であっても普段とあまり変わらない生活をしていた。

D 多くの人は、政府の自粛要請に反して、宣言中は寧ろ自粛せずに過ごしていた。

C.1.3. Preferences for strengthening the state's power and control rights

The respondents were also asked their opinions regarding how strong control rights and power should be that we give to the state as follows:

How many of the statements below do you agree with (Your answer must be an integer between 0 and 10)?

a. When the Covid-19 pandemic worsens and a state of emergency is declared, all bars, restaurants and other hospitality venues must be closed by law.
b. People who test positive but go out, refusing to self-quarantine, must be charged a fine by law.
c. The names of those who test positive but go out, breaking the self-quarantine rule, must be disclosed in public.
d. The police should strengthen the patrol duties to monitor people's self-restraint behaviors during the periods when the government's request for self-restraint is in effect.
e. Private enterprises' activities must be formally regulated by stipulating the percentage of time during which the employees work at home when a state of emergency is declared.
f. Wearing face coverings (e.g., mask) should be made obligatory by imposing a fine under a state of emergency.
g. The government should be given centralized power to order private hospitals to secure sufficient hospital beds for patient admission, thereby providing sufficient medical treatments to people who have tested positive.
h. Foreign travel by Japanese nationals should be banned under a state of emergency. Such regulation effectively prevents the spread of the coronavirus.
i. Activities in schools (primary, junior high and high schools, and universities) should be formally limited by the government under a state of emergency.
j. Especially when a state of emergency is declared or any other request for self-restraint is issued, the government should introduce mandatory Covid-19 passports for people to go out (e.g., to shops and restaurants), thus practically mandating vaccines.

[Original Japanese version of the question:]

新型コロナウィルスなど感染症対策に対して以下の記述のうち賛成は何個ありますか？

a. 新型コロナウィルスのまん延が悪化し非常事態宣言が発令される際には飲食店などは全て休業するよう義務づけるべきだ。
b. 新型コロナウィルスで陽性と判定された人が隔離期間中に外出した場合は罰金を科すべきだ。
c. 陽性者が隔離期間中に外出をした場合は名前を公表すべきだ。
d. 自粛要請期間中は人々の外出自粛のモニタリングのため警察がパトロールを強化すべきだ。

e. 非常事態宣言中、リモートワークの比率の設定などの義務を民間企業に課すべきだ。
f. 非常事態宣言中は罰則も含めマスクの着用を義務化すべきだ。
g. 新型コロナ患者の受け入れ・治療体制確保のため、民間病院に指示をして病床確保を中央集権的にできるように政府に権限を与えるべきだ。
h. 非常事態宣言時は海外からのウィルスの流入を防ぐために日本人の海外渡航・旅行を禁止にすべきだ。
i. 非常事態宣言中は学校（小・中・高校及び大学）の活動を政府は制限すべきだ。
j. 非常事態宣言やまん延防止等重点措置など自粛要請が出されているときは、新型コロナウィルスの更なるまん延を防止すべく、政府はワクチンパスポートを導入し、スーパーなどお店への入店や飲食に、ワクチン接種を義務化すべきだ。

C.1.4. Other questions that the respondents were asked for the purpose of controls

The following include only the translated English version to conserve space. The original Japanese version is available from the author upon request.

Question: The Tokyo Olympics took place in the summer of 2020, despite it being in the middle of the coronavirus crisis. Evaluate this decision on a five-point scale:

1. It was very good that the Olympics took place in 2020.
2. It was good that the Olympics took place in 2020.
3. I have no particular opinion.
4. It was bad that the Olympics took place in 2020.
5. It was very bad that the Olympics took place in 2020.

Question: How many doses of Covid-19 vaccines did you take?

A. Never.
B. The first dose only.
C. The first and second doses only.
D. Not only the first two doses but also the third (booster) dose.

Question: Answer the following questions.

(1) Gender {multiple choice: Male, Female, Other/Do not want to answer}

(2) Major (study area)

(3) Age

(4) Which year are you in at university?
    a. Third year (junior)
    b. Fourth year (senior)

(5) Hometown (the name of prefecture) # Write “foreign” if you are from a foreign country.

(6) Have you ever been infected by the coronavirus? (Have you ever been diagnosed by a doctor, a hospital, or a testing center as having been infected?)

a. Yes
b. No
c. Do not want to answer

(9) Do you have any underlying medical conditions?

a. Yes
b. No
c. Do not want to answer

(8) Do you currently live in your parents’ house? {multiple choice: Yes, No, Other / Do not want to answer}

(9) Do you currently live with your parents (and/or parents-in-law)? {multiple choice: Yes, No, Other / Do not want to answer}

(10) Do you currently live with your grandparents? {multiple choice: Yes, No, Other / Do not want to answer}

(11) Provide your father’s academic background. {multiple choice: university undergraduate degree or above, high school graduate, junior high school graduate, do not know / do not want to answer}

(12) Provide your mother’s academic background. {multiple choice: university undergraduate degree or above, high school graduate, junior high school graduate, do not know / do not want to answer}

(13) Indicate, on a five-point scale, how important religion is in your life. {This question was taken from the WVS.}

1. Not at all important
2. Not very important
3. Neutral
4. Rather Important
5. Very important

(14) How frequently do you drink? Answer on a five-point scale.

1. Do not drink at all
2. Once per month
3. Once per week
4. A few times per week
5. Almost every day

(15) How frequently do you smoke? Answer on a four-point scale.

1. I smoke almost every day.
2. I sometimes smoke.
3. I never smoke (although I have smoked in the past).
4. I never smoke (I have never smoked).

(16) How many gambles, among the following, have you ever engaged in? Answer by writing an integer between 0 and 7.

a. Horse racing (called “Keiba”)
b. boat racing (called “Kyotei”)
c. Bicycle racing (called “Keirin”)
d. Auto racing (called “Autorace”)
e. Japanese pinball (called “Pachinko”)
f. Online casino
g. Sports betting

(17) Generally, do you assume that other people (people except you) only have the best intentions? Answer on an eleven-point scale. {This question was taken from Falk *et al.* (2018)’s Global Preference Survey. The response to this question is considered as a trust measure in their study.}

They do not have the best intensions at all									They have the best intentions
0	1	2	3	4	5	6	7	8	9	10

(18) Suppose that you unexpectedly received 10,000 Japanese yen. How much of this amount would you donate? Answer using an integer. {This question was taken from Falk *et al.* (2018)’s Global Preference Survey. The response to this question is considered as an altruism measure in their study.}

(19) Generally, how willing are you to forego something that is beneficial to you today to benefit more from it in the future? Answer on an eleven-point scale. {This question was taken from Falk *et al.* (2018)’s Global Preference Survey. The response to this question is considered as a time preference measure in their study.}

Not willing to give up today’s benefits									Willing to give up to receive more in the future
0	1	2	3	4	5	6	7	8	9	10

(20) Generally, how willing are you to take risks? Answer on an eleven-point scale. {This question was taken from Falk *et al.* (2018)’s Global Preference Survey. The response to this question is considered as a risk preference measure in their study.}

Avoid risks as much as possible										Willing to take risks
0	1	2	3	4	5	6	7	8	9	10

(21) How frequently do you impulsively buy luxuries or something other than daily necessities? Answer on an eleven-point scale.

Not at all										Very frequently
0	1	2	3	4	5	6	7	8	9	10

C.2. Results

This section reports the regression results from exploring how people's degree of self-control affects their support for the state's stronger control rights and power during the Covid-19 pandemic. The dependent variable is the number of examples with which a respondent agrees that strengthen the formal enforcement of restriction measures (see Section C.1.3 for the details). Two regression models (linear and tobit regressions) were estimated because the dependent variable is censored. Columns (1) and (5) of the table below include the respondents' degree of weak self-control, i.e., their response to the question in Section C.1.1, as the only independent variable. The results show that those with weaker self-control are significantly more likely to support strengthening the formal enforcement of restrictions, consistent with commitment theory (e.g., Gul and Pesendorfer, 2001). Columns (3) and (7) add controls collected from the respondents to evaluate the robustness of the main finding;[16] it is found that the positive correlation described above changes little with the addition.

As discussed in the paper, both the respondents' preferences for strong formal enforcement and their self-control behaviors may be affected by their perception of others' self-control behaviors. A Ramsey test for Column (1) indicates that one cannot reject the null that the model has no omitted variable at the 5% level, although one can at the 10% level. Thus, the data on the perception variable collected from the respondents (see Section C.1.2) was additionally included in the even-numbered columns in the table to further evaluate the robustness of the finding. The test obtains a statistically significant result of the same magnitude as that of the main result, which is that respondents with weaker self-control more strongly support the strengthening of formal enforcement.

Dependent variable: A subject's response to the question in C.1.3, i.e., the number of examples with which they agree that support the strengthening of the state's control rights and power {= 0, 1, 2, …, 10}

Estimation method:	Linear regression with robust standard errors				Tobit regression with robust standard errors			
Independent variables:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) Degree of weak self-control behaviors {i.e., responses to the question in C.1.1}	0.207**	0.205**	0.222**	0.217**	0.225**	0.222**	0.239**	0.233**
	(0.092)	(0.091)	(0.091)	(0.091)	(0.100)	(0.099)	(0.961)	(0.096)

[16] The control variables include the number of Covid-19 vaccines they took, a female dummy, an economics major dummy, a fourth-year dummy (all subjects were either third- or fourth-year undergraduate students), an infection dummy (which equals 1 if a respondent has ever been tested positive), an underlying medical condition dummy (which equals 1 if a respondent has a medical condition or more), a dummy that equals 1 if a respondent lives with their (grand)parents, the degree of their belief in religion (taken from the WVS), their gambling experiences, four variables from Falk *et al.*'s Global Preference Survey (altruism, donation, patience, and risk preference), and their degree of impulse buying. See Appendix Section C.1.4 for the details.

(b) Perception of others' self-control {i.e., responses to the question in C.1.2}	---	0.228 (0.237)	---	0.275 (0.250)	---	0.238 (0.251)	---	0.299 (0.256)
Constant term	2.853*** (0.392)	2.435*** (0.560)	2.699*** (0.894)	1.982* (1.037)	2.720*** (0.432)	2.286*** (0.592)	2.361** (0.941)	1.585 (1.104)
Control variable	No	No	Yes	Yes	No	No	Yes	Yes
# of observations (respondents)	298	298	298	298	298	298	298	298
F	5.11	3.27	0.98	1.08	5.08	3.35	1.00	1.11
Prob > F	0.025	0.039	0.474	0.379	0.025	0.036	0.456	0.343
Ramsey test using powers of the fitted values of law								
The following shows the two-sided *p* for Ho: model has no omitted variables								
	0.055*	0.224	0.644	0.288	---	---	---	---

Note: The numbers in parentheses are robust standard errors. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.

As discussed in the paper, the degree of a respondent's weak self-control behaviors can theoretically be thought of as an integer between 3 and 7. Most respondents' answers were in that range, as reported in Footnote 15 of the paper. However, as a robustness test of the regression result reported above, an additional regression was performed by converting respondents' answers below 3 (above 7) to 3 (7), because the answers outside the range are potentially difficult to interpret. For example, consider a respondent who answered 10 (i.e., all ten examples in Section C.1.1 were applicable to the subject). This person did not strictly comply with the stay-home request, although they behaved carefully in public spaces, for example by maintaining a social distance with others. This person cannot be considered to have weaker self-control than one who agreed with seven weak self-control examples while they did not agree with the three careful self-restraint examples (hence the latter's answer of 7). For another example, consider a respondent who answered 1 in the question. Suppose that this person assumed that only the social distance example was applicable to them. The reason why they did not check the other two examples of high self-restraint behaviors might simply be that they rigorously complied with the stay-home request and therefore, for example, did not need to bring antibacterial wipe(s) or spray with them. As it is difficult to compare the respondents' answers of, say 1 and 3 (or say 7 and 10), their answers are truncated at 3 and 7. The following table includes the results when the same regression models were estimated, but with the dependent variable censored at 3 and 7. The main result (the respondents with weaker self-control are more likely to support the strengthening of formal enforcement) changes little with the amendment of the dependent variable.

Dependent variable: A subject's response to the question in C.1.3, i.e., the number of examples with which they agree that support the strengthening of the state's control rights and power {= 3, 4, 5, 6, 7}

Estimation method:	Linear regression with robust standard errors				Tobit regression with robust standard errors			
Independent variables:	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(a) Degree of weak self-control behaviors {i.e., responses to the question in C.1.1}	0.293*** (0.110)	0.286*** (0.110)	0.314*** (0.109)	0.304*** (0.109)	0.458** (0.178)	0.458** (0.179)	0.476*** (0.174)	0.473*** (0.176)

(b) Perception of others' self-control {i.e., responses to the question in C.1.2}	---	0.209 (0.238)	---	0.255 (0.250)	---	0.012 (0.368)	---	0.070 0.385)
Constant term	2.464*** (0.477)	2.097*** (0.612)	2.234** (0.921)	1.591 (1.050)	1.190 (0.817)	1.170 (1.005)	1.128 (1.463)	0.952 (1.691)
Control variable	No	No	Yes	Yes	No	No	Yes	Yes
# of observations (respondents)	298	298	298	298	298	298	298	298
F	7.13	4.15	1.22	1.27	6.61	3.32	1.11	1.06
Prob > F	0.008	0.017	0.252	0.218	0.011	0.037	0.347	0.392
Ramsey test using powers of the fitted values of law								
The following shows the two-sided *p* for Ho: model has no omitted variables								
	0.004***	0.443	0.379	0.276	---	---	---	---

Note: The numbers in parentheses are robust standard errors. *, **, and *** indicate significance at the 0.10, 0.05, and 0.01 levels, respectively.