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Varying experimental instructions to improve comprehension: Punishment in public goods games

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ABSTRACT

We provide evidence that more explicit instructions can affect behaviour in a public goods game with punishment. Instructions that highlight the positive externality associated with public goods contributions and provide more examples improve subjects' comprehension levels, as measured by shorter decision times in the experiment. They also lead to higher contribution levels in games with punishment opportunities, linked to better targeting of punishment.

1. Introduction

There is ample evidence that the format in which instructions are presented to students can significantly influence the degree to which learning can be facilitated. Chandler and Sweller (1991) develop the cognitive load theory to argue that information should be presented in ways that do not impose heavy cognitive loads – otherwise hampering learning. Modern versions differentiate three kinds of cognitive loads: intrinsic (the complexity of the matter itself), germane (effective) and extraneous (irrelevant). While these principles have guided the design of instructions in (educational) psychology and educational research (see De Jong, 2010), there has been little research in experimental economics that focuses explicitly on how alternative instructions impact subjects' understanding of the decision task.

A large amount of attention has, instead, focused on the effects of decision frames on behaviour. Since the seminal work by Tversky and Kahnemann (1981), plenty of experimental work in economics has analysed how the description of decision problems and strategic situations affects people's perception of the situation, and their choices and behaviour. As relevant examples for our research, in a public goods game, Andreoni (1995) studies the differences in contributions in positive vs negative frames and, more recently, Cubitt et al. (2011) and Ramalingam et al. (2017) study differences in contribution and punishment behaviour in one-shot and repeated provision vs appropriation games.

In this paper, we study the effect of the instruction format not on subjects' perception of a situation but on subjects' comprehension of the situation, designing instructions to increase subject comprehension of the incentive structures of the laboratory decision setting. Ultimately, the goal is to study whether higher comprehension affects behaviour.

Recent work documents that instruction format can have significant effects on comprehension levels of subjects in economics experiments. In a repeated linear public goods experiment, Bigoni and Dragone (2012) (henceforth BD12) identify two factors that influence the effectiveness of experimental instructions – their length and subjects' active involvement. They find that short on-screen instructions worsen comprehension (measured by the number of wrong answers, and the time taken to answer a pre-experiment quiz), while instructions of a similar length that required subjects to actively solve examples during the instruction stage were found to increase comprehension levels.[1] However, BD12 do not find evidence that differences in comprehension levels are associated with differences in contributions. They

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[1] They did not run treatments with online long instructions or long instructions that required active input.

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observe the usual pattern of behaviour (see Chaudhuri, 2011), with declining contributions across treatments.

While these results regarding behaviour might be reassuring at first glance, there are reasons for further investigation into this aspect of the experimental methodology. A possible reason for the finding of BD12 is the relatively simple nature of the public goods game where a participant makes one decision - contribution - in each round. Instruction length and format may thus not have serious implications for behaviour in such a setting. However, combined with previous evidence that some subjects' decisions appear to be at least partially linked to confusion (see Andreoni, 1995), it is plausible that lack of comprehension would have more noticeable effects on behaviour in more complicated settings.[2]

As suggested by Cognitive Load Theory, intrinsic cognitive load is higher in more complex settings. However, instructions designed to improve understanding of the more complex setting are likely to reduce the germane load on experimental subjects. It is plausible that such instructions have an impact on behaviour because they reduce the overall cognitive load. Our study presents evidence that supports this conjecture.[3]

One of the most studied results in the social dilemmas literature is the ability of groups to use peer punishment to govern themselves, i.e., to raise cooperation levels and sustain these higher levels over time (for instance, Ostrom et al., 1992 and Fehr and Gächter, 2000). Successful punishment is associated with three factors: (i) sufficient punishment to render the threat credible, (ii) punishment targeted at free-riders, and (iii) punishment of low contributors not being crowded-out by anti-social punishment of high contributors (see Herrmann et al., 2008 and Rand et al., 2010).

Arguably, therefore, the punishment game is more complex than a simple public goods game without the option to sanction one another. First, there are more decisions to make in the game with punishment. Second, the punishment decision involves more complicated reasoning on the part of subjects in identifying who and how much to punish. If, as has been shown, instruction length has significant effects on comprehension, we are more likely to see effects on outcomes in more complicated settings, i.e., in the punishment game. Given the increasing complexity of some experiments in recent times, and the resulting wide variety of instructions used, it is extremely important, and timely, to investigate the potential effects that instruction format and complexity may have on subject comprehension levels and behaviour.

In this study we examine the effect of instruction format on decisions in two environments that differ in complexity; experimental public goods games with and without punishment opportunities. Thus, our treatments vary along two dimensions – availability of punishment and format of instructions – to implement a 2×2 design. In all four treatments, subjects played a repeated linear public goods game using the Voluntary Contributions Mechanism (VCM). In two treatments, subjects played only the VCM. In the remaining two treatments, subjects played a two-stage game where the first stage was the VCM. In the second stage, subjects could use their earnings from the first stage to sanction each other (as in Gächter et al., 2008).

In one pair of VCM and punishment treatments, subjects were given short instructions while in the other pair, subjects were given longer instructions that made explicit the positive externality associated with contributions to the public good. Versions of both sets of instructions have been widely used. The longer instructions were based on Gächter et al. (2008) while the shorter instructions were based on Fatas and Mateu (2015). We used important elements from the instructions in these papers and further adapted them to reflect our experimental parameters.

While punishment experiments that use the longer instructions (including Gächter et al., 2008) have generated sustained increases in contributions, Fatas and Mateu (2015) find only modest increases in contributions. To the best of our knowledge, there has been no systematic investigation of such differences in punishment behaviour, or of reasons for the differences. It is thus not yet clear if, or how, the length and format of instructions may have an influence on observed differences across studies examining the punishment institution.

The two instruction formats in our study differed in important respects. First, the shorter instructions were one and two pages long respectively for the games with and without punishment while the corresponding longer instructions were three and four pages long. Second, the shorter instructions had only two solved examples each while the longer instructions had three examples each. Third, and perhaps most important, the longer instructions made salient the positive externality inherent in the public goods game while the shorter instructions stopped with the description of the game and calculation of payoffs.

Our results lend support to the findings in BD12. As in BD12, we find that the shorter instructions do negatively affect comprehension levels in the VCM. When given shorter instructions, subjects took significantly longer to make contribution decisions in each round. As in BD12, we find that average contributions start higher in the VCM sessions with longer instructions, but averages across all decision rounds are similar and show the common trend of declining contributions across all decisions rounds.

As in the VCM, comprehension levels were significantly lower in the shorter instructions punishment treatment. Subjects took significantly longer to make contribution and punishment decisions when they were given short instructions. What is different is that instruction length is associated with significant differences in behaviour in the punishment game. We find that when given the short instructions, groups were less successful in raising contribution levels. At best, they were able to stem the decline observed in the VCM across decision rounds. On the other hand, groups that received the longer more explicit instructions raised contributions to 75% of endowment and were able to sustain this higher level throughout the game. This is driven by differences in punishment behaviour – low contributors were targeted for punishment much more often.

The rest of the paper is organised as follows. Section 2 details our experimental design and presents the crucial differences between instruction formats. Section 3 presents our hypotheses, Section 4 presents our results, and Section 5 concludes. Appendix A contains the experimental instructions for all our treatments. Appendix B contains the pre-experiment quizzes that subjects had to answer. Appendix C presents additional analysis that explores subjects' response times further, and heterogeneity among groups in the punishment treatments.

2. Experimental design

In all treatments, groups of four subjects played a repeated VCM game. Each player was endowed with 20 tokens which could be invested in an *Individual Project (IP)* or in a *Group Project (GP)*. A token invested in the IP yielded a return of one token and a token invested in the GP yielded a return of 0.5 tokens for each of the four group members, i.e., MPCR = 0.5. The per-period payoff of player i ($i = 1, 2, 3, 4$) is given by

$$\pi_i(c) = (20 - c_i) + 0.5 \sum_{i=1}^{n} c_i,$$

where c_i is i's contribution to the public good, and c is the contribution profile in the group. The Nash equilibrium, based on self-regarding preferences and the same belief for all other players, is for all players to

[2] BD12 note that their conclusions may "depend on the complexity of the task" (p. 463).

[3] We are aware of one other work that looks at different instruction formats, based on Cognitive Load Theory. Kirmes (2014) provides preliminary evidence from a pilot experiment that instructions with stick-figure illustrations (that help understanding by reducing the germane load) reduce decision times in public goods and market entry games. However, given that these results are preliminary, the findings are not conclusive.