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How to subsidize contributions to public goods: Does the frog jump out of the boiling water?☆

Theo Offerman [a], Ailko van der Veen [b,*]

[a] University of Amsterdam, Netherlands
[b] University of East Anglia, UK

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ABSTRACT

According to popular belief, frogs are boiled to death when the water is heated gradually. In this paper, we investigate how humans respond to a very slow versus a very steep increase of a subsidy on contributions to a public good. In an experiment, we vary the mode of the increase (gradual versus quick). When the subsidy is raised to an intermediate level, we see a modest effect in either treatment. When the subsidy is raised to a substantial level, there is a strong effect of a quick increase and a modest effect of a gradual increase in the subsidy.

1. Introduction

Governments around the world subsidize contributions to public goods. Sometimes the subsidy is abruptly introduced in one step.[1] In other cases, the subsidy is introduced gradually in small steps. In the messy world of policy, subsidies are often changed gradually as a response to unforeseen events, or because it is too difficult to reach agreement on a substantial change.[2] The question is whether a positive effect of a subsidy on people's behavior is lost when the subsidy is introduced in multiple small steps. So far, there are no experimental findings on this question. In this paper, we compare the effectiveness of an instantaneous rise in the subsidy to a slow rise of the subsidy to the same ultimate level in a series of experiments.

Doing so we test a conjecture formulated by Al Gore in the 2006 movie “An inconvenient truth”. Gore claims that humans have a tendency to ignore changes in the environment when these changes occur at a very slow pace. Therefore,

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* Corresponding author.
E-mail address: A.vanderVeen@uva.nl (A. van der Veen).

[1] For instance, in 2009, the Chinese government announced the most aggressive subsidy on solar panels in the world. By providing a subsidy of 20 yuan per watt, the Chinese essentially covered half the cost of entire solar panel installations.

[2] In 2009, Japan launched a feed-in tariff that requires utilities to buy excess solar power generated by homes and business at a higher price than the standard rate. After the Fukushima meltdown in 2011, Japan raised the feed-in tariff to almost three times the price industrial users paid for conventional power. There are similar cases where negative subsidies (taxes) are changed. For instance, the European Commission abolished in one time the 66.1% import duty on energy saving compact fluorescent lamps from China in October 2008. In contrast, in the Netherlands the duty on petrol was enhanced in numerous tiny amounts from 46.1% in 1993 to 69.7% in 2008. By increasing the duty on petrol, the Dutch effectively subsidize people who opt for public transport.

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there is a danger that humans fail to respond while the climate deteriorates by the very gradual process of global warming. Gore draws an analogy between the boiling frog story and the inertia of humans: "If a frog jumps into a pot of boiling water, it jumps right out again, because it senses the danger. But the very same frog, if it jumps into a pot of lukewarm water that is slowly brought to a boil, will just sit there and it won't move." He concludes: "Our collective nervous system is like that frog's nervous system … If it seems gradual, … we are capable of just sitting there and not reacting."[3] In a similar vein, Krugman (2009) argues in the New York Times that humans will fail to respond to "the creeping threat" of climate change. The goal of our study is to investigate whether humans fail to react when slow changes in the environment increase the importance of contributions to the public good, as suggested by Gore and Krugman.

To enhance the external validity of our study, we chose to use a dual task procedure in the experiment. In the real world, contributing to a public good is one of many decisions that people continuously make. For instance, when we are cold in winter we may at any moment decide to put on an extra sweater or to set the thermostat a few degrees higher. At the same time, other activities continuously compete for our attention. To mimic this situation in the laboratory, our subjects continuously and simultaneously earn money with an individual task (their daily activities) and with their contributions to a public good. They can switch from the one task to the other task whenever they wish. While they are playing the game, we increase the subsidy to the contributions of the public good. We think this is a large step forward compared to other experiments in economics and psychology, where subjects usually focus on only the public good task. At the same time, there remain some important differences between our experiment and the "real world" outside the laboratory. For instance, the time dimension in the experiment is vastly different than in the world outside the laboratory. In the context of the experiment, a gradual change of the subsidy occurs in 17 min, while the corresponding process outside of the laboratory may take years. Given that our subjects had the possibility to change their decision every second, 17 min may have felt as a long time, though. Still, factors like the time dimension limit the external validity of our experiment to some extent.

In our experiments, we make use of a linear public good game where selfish subjects have a dominant strategy to completely free ride in the stage game for any level of the subsidy that we employed. Although the game was repeated for an unknown number of seconds, selfish subjects could not support cooperation in equilibrium because subjects did not receive information about others' contributions during the public good game. Therefore, from a strategic point of view the game is essentially a one-shot game.

Nevertheless, there is a vast literature on public good games that furnished our conjecture that we would observe positive contributions when contributions were subsidized.[4] In essence, a subsidy on subjects' contributions to public goods corresponds to an increase in the MPCR.

In a first series of experiments, we raised the subsidy level from 0% to 45%. Here, we do not observe significant differences between the treatment where the subsidy is introduced in one big step and the treatment where it is introduced in many small steps. With a maximum of 45%, the subsidy only marginally increases contributions in either case, though. Therefore, we decided to run an additional series of experiments where we raised the subsidy to 75%. Here, there is a substantial effect of the subsidy when it is introduced instantaneously while there is at best a modest effect when it is introduced gradually. The difference in the fractions of people responding positively to the subsidy equals 27 percentage points. This difference is significant and persistent. Given that subject respond positively to the subsidy, they enhance their contributions to the same extent in both treatments.

Our study also sheds light on potential explanations of the boiling frog phenomenon. One possibility is that the phenomenon is driven by the beliefs of conditional cooperators. Conditional cooperators may believe that others will only fail to respond to a change in the subsidy if it is introduced in tiny steps. With such beliefs, conditional cooperators may only respond to the subsidy when it is introduced in one big step.

There is, however, also a possibility that the boiling frog effect in public good games is driven by anchoring (Tversky and Kahneman, 1974). Anchoring occurs if a decision-maker only changes her initial subjectively optimal decision if she perceives a sufficiently substantial instantaneous change in the situation. If she considers the situation to have remained approximately constant, she trusts that the previous decision is still optimal. "Costs of thinking" may provide an important source for the success of such anchoring. The mistake that people make is that they do not (sufficiently) take into account that their previous inactiveness to small changes diminished the quality of the original decision for the more recent situation. People fail to recognize that their original decision ceases to be optimal once the situation has substantially changed through many small steps in the same direction.[5]

[3] Although the boiling frog story is currently challenged, actual investigations on frogs published in the 19th century claim support for it (see Appendix A).

[4] One of the stylized facts in experiments on linear public good games is that subjects respond to how productive a contribution to the public good is. Isaac and Walker (1988) and Isaac et al. (1994) were among the first ones to find a positive effect of an increase in the Marginal Per Capita Return (MPCR), the marginal benefit that each player earns from the contribution of an extra dollar to the public good, on subjects' contributions to the public good. There are two possible causes behind subjects' responsiveness to the MPCR. One possibility is that subjects do not only care about their own payoff but also about the material payoff of other subjects. Material altruists are more inclined to contribute with a higher MPCR because it makes their contribution more effective (Goeree et al., 2002). The other possibility is that a higher MPCR boosts contributions because it makes conditional cooperators more optimistic about the extent to which others cooperate (Offerman et al., 1996; Fischbacher et al., 2001; Brandts and Schram, 2001).

[5] Many studies have shown that people do not move sufficiently in the right direction away from their reference point or anchor. For instance, Northcraft and Neale (1987) find that respondents often quote a too high selling price for a house if they are given a reference point that is higher than the actual selling price and vice versa. Anchoring also explains why people often choose the firm's default in the 401(k) savings plan (Madrian and Shea, 2001).